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THE RIGHT HON. LORD HAMPTON, G.C.B., &c., &c., &c., in
the Chair.

DISCUSSION ON THE PRIZE AND OTHER NAVAL ESSAYS OF 1878.

HEADS OF SUBJECTS TREATED, DRAWN UP IN ORDER TO
FACILITATE DISCUSSION.

THE Essays are four in number, viz. :—The Prize Essay, by Captain P. H. Colomb, R.N.; that by Commander Noel; that by Lieutenant James B. Haye; and that by Lieutenant Sydney M. Eardley-Wilmot.

The Prize Essay,

after an introductory survey of the British Naval Empire, its strength and weakness, passes to the geographical distribution of British ports of supply, and rests the propulsive powers of the necessary war ships upon these geographical facts.

Our naval policy, the Essay observes, should rest upon—

- (1) The geographical position of our Naval Empire;
- (2) Our actual peace Navy;
- (3) The geographical condition of a possible naval combination against us, and the nature and distribution of neighbouring naval forces.

Passing to the ship-construction necessary to satisfy these conditions, the Essay asks for moderate speed, twin screws, coal capacity to steam 4,000 miles at five knots, and an auxiliary sail power.

Every other quality must give way to the provision of the coal supply named.

The Essay lays great stress on the establishment of a definite classification of ships, and recommends four classes, viz. :—

- (1.) The fleet-ship of 6,000 to 8,000 tons.
- (2.) The frigate of 4,000 tons.
- (3.) The corvette of 2,000 tons.
- (4.) The sloop of 600 to 1,000 tons.
- (5.) Gunboats, torpedo vessels, despatch vessels, &c.

One great principle of "duality" should pervade all war ships. Each should be able in all cases to stand one blow, or one accident, without being totally disabled. Everything, in fact, should be double; two engines, two sets of boilers, two bottoms and sides, compartments so multiplied that no two when filled would disable the ship, two sets of pumps and fire-engines, two sets of steering gear, double armament, and where possible two separate batteries.

Coming to the construction of each class, and taking first the "fleet-ship," the turret ship is abandoned and the broadside upheld.

The "Inflexible" type is condemned as being too costly a structure for the carriage of only four guns, however great the individual power of each may be.

By new arrangement of armour and armament in a ship called the "Outrageous," the essay seeks to show how for a 6,000-ton ship, 10-inch armour may be substituted for 6 and 8-inch; and how twelve 18-ton guns on the broadside may take the place of ten 12-ton guns. How also a second armament of light guns on an upper deck may resist the attack of gunboats, torpedo vessels, and unarmoured ships carrying armour-piercing guns.

In all constructions the point insisted on is that the standard or measure of power must be *COST*. It is argued that if a ship is *twice* as strong as another, but costs *three times* as much, she should be looked on as the weaker of the two when considered as an item of naval policy.

The "frigate" should be a smaller "fleet-ship," with armour in like proportion.

The "corvette" would not greatly differ from the present type, except as to twin screws and reduced sail power.

The sloop would not greatly differ from the "Frolic" and "Kestrel" class.

Gunboats, &c., would differ from all previous classes, inasmuch as they would be designed for special service in special localities, whereas every ship in the four classes would be for "general service."

Respecting the two great questions of "End-on *versus* Broadside Fire?" and of "Few heavy, or many light, guns for the unarmoured ship?" the essay gives up "end-on fire" as immaterial; and supports "many light guns" against "few heavy ones" as a general principle. But all fleet-ships and frigates should have a double armament of heavy guns to fight their fellows, and of light guns to meet the attack of numerous small craft.

The sloop, as a ship for inshore duties, requires one or more heavy guns for operating against batteries and ships seeking the security of shoal water, but requires a numerous light armament to sustain her against a ship of her class so armed.

Passing to the present peace establishment of our Navy, the Essay finds that on January 1st, 1877, we had on duty in various parts of the world 13 fleet-ships, 12 frigates, 18 corvettes, 38 sloops, 46 gunboats, and 60 despatch vessels.

The Essay holds that the chief use of the fleet-ship in war would be to blockade military ports, and to act in concert against escaped squadrons of the enemy.

The frigate would have like duties, but would also guard threatened lines of communication.

The corvette and the sloop would operate directly as commerce protectors, keeping open the sea routes and guarding coaling stations from isolated attacks.

The sloops would operate inshore, and would supplement the duties of the corvette.

On a survey of our position with a very large European coalition against us, the essay does not see much difficulty in meeting it, so long as a definite naval policy, on the grounds sketched out, is maintained.

On the question of harbour defence the essay condemns the "harbour defence ships," but commends torpedo vessels and coast volunteer forces.

On the general question of "weapons," the Prize Essay recommends the ram for all classes of ships, abandons the Harvey torpedo as practically useless, and considers the Whitehead torpedo as yet untried. It considers that armour plating is yet more in its infancy than gunpowder, and thinks the gun is nearer its limit of penetration than armour of its resistance. The spar torpedo is probably the most effective weapon for harbour defence, provided it be in the hands of daring men.

Commander Noel's Essay.

Commander Noel, after a discussion on naval policy and administration, which was thought by the referees to be beyond the scope of the inquiry, passes at once to a description of the fighting ships proper to be employed.

He divides the Navy into four classes of ships:—

- (1.) The ironclad proper.
- (2.) The ocean cruiser, perhaps partly armoured.
- (3.) The smaller sea-going cruiser.
- (4.) The coast defence ironclads, the gunboats and torpedo vessels.

Taking the ironclad first, he considers she must be prepared to fight a naval duel; to take part in the line of battle; to oppose successfully a squadron of gunboats; to engage forts; and, lastly, to fight two or more unarmoured vessels.

In view of these contingencies she must be a ram; must carry a fair number of guns from 12 to 20 tons weight, the guns to have 90° training; and torpedoes to a safe extent.

His type becomes a broadside ship, with an armour belt at the water line, and carried up to the lower port-sills, and with transverse armour bulkheads to protect from raking fire.

The weights are thus distributed:—Taking the total weight as 1, then .225 goes to armour, .1 to armament, and .125 to coal. A ship of 8,000 tons would thus have 1,800 tons of armour, 800 tons of armament, and 1,000 tons of coal. The ship is to be fully rigged.

The second series of ships should consist of corvettes and frigates of 2,000 to 5,000 tons. They are to be rams, with .06 of armour to protect vital parts; the armament to be .08, and coal .16 of the displacement. The armament of the frigate would be 6½-ton guns, and of the corvette twenty 64-pounders. The ships should be fully rigged.

“Special cruisers” without armour and of great speed should form part of the “ocean cruisers” series. A 2,000-ton ship of this class would carry 60 tons of armament and 400 tons of coal.

The third series of ships consists of sloops and gunboats, should vary in size and description, according to the service for which they are designed; to be fully rigged, to “economise fuel and afford instruction in seamanship, as well as to have the “power of moving from port to port.”

In the fourth series of ships Commander Noel includes the “ironclad, or first class” of vessel for coast defence at home and abroad, should as nearly as possible represent “a floating fort, her steaming power and seaworthiness being sufficient to ensure her “safety if caught in a gale on the coast she has to defend. Sail power is unnecessary, as also great speed under steam, but her principal object will be to carry a “powerful armament and heavy armour.”

Such a coast vessel would be of 10,000 tons displacement, carrying twelve 38-ton guns in single turrets, or on the Moncrieff system, *en barbette*.

Coast defence would be completed by gunboats carrying one heavy gun each, and supported by small swift torpedo vessels.

Fast merchant steamers lightly armed are approved of as useful adjuncts, as advocated by Mr. Brassey and the late Mr. W. S. Lindsay.

Commander Noel next passes to the question of “Organization,” and takes up the entry and education and training of Officers and men.

Cadets should be entered between the ages of fourteen and fifteen, and selected by means of test examinations. Then to have six months’ training on shore or in a harbour ship, and nine months’ in a sea-going training ship of 1,800 tons. Then, to be appointed midshipman in a man-of-war, and at the age of nineteen to pass the final examination as at present.

Commander Noel thinks that the days of Gunnery Lieutenants are numbered, as every Lieutenant should be competent to fulfil those duties. He commends the abolition of a separate class of navigating Officers, and thinks that navigating Commanders might be employed on the Admiral’s staff.

Respecting the engineer Officers, Commander Noel applauds the French system, and thinks that if the Admiralty manufactured their own engines, a more perfect training for engineer Officers might be had.

Speaking of the seamen, Commander Noel says their entry and training is more satisfactory now than it has ever been before. We have enough seamen for our present requirements, but it would be better to have 20,000 seamen proper, and to enter 3,500 boys yearly with that view.

Naval barracks in our principal dockyards would facilitate training. There parade drills should be given up and the men taught to be riflemen, ship artillerymen, swordsmen, but above all they must be seamen.

Speaking of the marine forces, Commander Noel does not think their presence on board ships of war is necessary for the purposes of discipline, but purely military

duties and those of domesticies are exactly suited to marines on board ship. All attempts to turn the seaman into a soldier Commander Noel trusts will fail.

It is impossible that the Royal Marine Artillery should exist on its present footing much longer, and it is suggested that they might become a corps of torpedo men, or "Royal Marine Engineers."

Of the reserve men, Commander Noel asks for 20,000 of the first class reserve, and to abolish the second class when these are secured. The present system of training answers admirably, and if England were really in danger, a large number of men who had served in the Navy would be found ready to serve again.

Lieutenant James B. Haye

proposes to arrange the ships in classes.

- (1.) Experimental ships of all natures.
- (2.) Ironclads of light draught.
- (3.) Ironclads (without masts).
- (4.) Ironclads (rigged).
- (5.) Cruizers.
- (6.) Other vessels.

The first series would include "Inflexibles," "rams" pure and simple, "torpedo-boats," and "circular ships."

The second series includes the "Cyclops" and "Glatton" classes.

The third series is represented by the "Devastation" and "Thunderer." The third series is represented by Captain Scott's "Victory."

The fourth series embraces ships such as the "Northampton," "Inconstant," "Flamingo," and "Lily."

The fifth series would include the "Mallard," "Spey," "Snake," Chinese "Gamma," and "Salamis" classes.

As to the modes of propulsion, Lieutenant Haye appears to object to the twin screw for all classes, on account of their liability to foul. Sail power, abandoned altogether in the second and third series, should be dispensed with as far as possible in the fifth series, the "cruizers," and apparently chiefly confined to the fourth series, the second class ironclads. The turbine is recommended, if it is necessary to rely on sail power.

The essayist next offers observations on the interior arrangements of the fighting ships: conning towers, steering gear, voice tubes, signals, &c., &c.

Of the Harvey torpedo he says, "It is doubtful if this torpedo will ever play a prominent part in future naval warfare." He places value on the spar torpedo, but much more on the Whitehead.

Speaking generally of sail power, the essayist says that, as long as we hold our coal depôts, sail power may be dispensed with to a very great extent, but "other nations could not so well dispense with sail power."

Coming to armament, Lieutenant Haye, while admitting that heavier guns must be carried in special ships to compete with foreign Powers, says that the 38-ton gun may be taken as most suitable for the heavy ironclads, the lighter ironclads of the fourth series carrying the 18-ton gun. These ships should have also a light armament of 12 or 20-pounders for use against torpedo vessels, enemy's open ports, &c.

Respecting bow and stern fire, the essayist holds that the latter at least must be retained as a defence against rams.

The protection of our commerce must rest upon the security of a sufficient number of outlying depôts. These should have despatch, look-out, gun, and torpedo vessels, permanently attached to them, and, in some cases, even mastless ironclads.

Merchant steamers must be lightly armed, fitted for using Harvey's torpedoes, strengthened at the bow for ramming, and divided into several watertight compartments. Fast ocean steamers must depend principally on their speed. The system of convoys must be revised for the slower steamers.

The naval volunteer or supplemental force embraces all our reserves. We cannot expect a large reserve of men who have served in the Navy. The Coast Guard is commended. In war time there would be such a demand for Royal Naval Reserve men for merchant ships that few would be available for the fleet. Gunboats should be attached to each district to train reserve men in firing at sea.

The reserves should be divided into two classes, the reserve for general service, and the Coast Defence Corps for local service. The present Royal Naval Reserve should form the Reserve proper, and the Coast Guard and Royal Naval Artillery Volunteers the Coast Defence Corps. All reserves should be under the command of an Admiral with a proper staff. The coast to be divided into districts and divisions as at present, each under the command of proper Officers.

As to colonial and home defence "our best defence is to take the initiative," by blockading the coast of a possible invader, and by continued naval and military expeditions to attack or threaten the enemy wherever he may be vulnerable.

The essay closes with remarks on the entry and training of Officers and seamen.

Lieutenant Eardley-Wilmot.

Lieutenant Wilmot begins his Essay by an introduction asserting that naval power is weakened when the fighting ships of one Power greatly preponderate; when the neutral flag covers enemies' goods; when privateering is abolished; and when from colonies the right to equip supplemental forces is taken.

The Navy cannot be considered solely defensive as it covers attacks.

Crippling commercial intercourse is one of the chief aims of a Navy. "Fighting ships" must be compromises. They must have speed; handiness; heavy armament; armour for guns and vital parts: stowage for fuel; must offer a small mark; must have numerous compartments; and the cost must be small.

Fourteen knots should be the lowest speed. Sacrifices must be made to get turning power.

Broadside fire is important.

Few heavy guns are preferable to many light guns.

The gunners must be protected even if the ships be made more vulnerable.

Masts should be abolished in ironclads.

There should be coal stowage enough to enable them to steam from England to Malta at 10 knots.

There should be two sets of engines and boilers at least.

Doors in watertight compartments should be above water.

The "Inflexible" type is too costly for a single ship.

The ship for service in the Channel and Mediterranean should be a mastless turret ship, of 250 feet in length and 100 feet beam, with a speed of 14 knots, and the turrets placed abreast of each other, so as to give a perfect bow and stern fire.

For distant service, the "Hercules" and "Triumph" represent the type of ship preferred.

Coming to the protection of our commerce, the Essay observes that our supplies at home could never be stopped while we have an adequate force to keep the command of the sea. We have nothing to fear from making everything which may assist a nation contraband of war, because we possess such a reserve of power and vitality in a maritime aspect, that only an impossible combination could stop our vessels from carrying our trade to all parts of the world.

In considering vessels of war for protecting our commerce, there has been a tendency to imagine a vessel can combine every attribute, and disappointment has resulted.

For an ordinary cruiser we require:—speed; moderate size; coal-carrying capacity; moderate cost; ability to carry one or two heavy guns. They should be about 200 feet long, 35 feet beam, 1,800 tons, and 3,000 horse-power. They should have a mixed armament of heavy and light guns. Spars should be light, and spread of canvas in proportion. They should have the Whitehead torpedo. 15 knots' speed should be realized, and no sacrifice of steam power should be made to give sailing power.

The "belted cruiser" is not approved.

Armed merchant steamers would be useful, but it would be short-sighted policy to depend entirely on them.

As to the Naval Volunteers, or supplemental force, the Essay declares that the question of an adequate reserve of seamen is not yet answered. There would be a

want of experienced seamen, which would be felt at the beginning of a war, because our supply of men is kept up by the entry of boys, and because a large portion leave the Navy after serving ten years as men. The rate of pay should be further increased, to induce the good men to serve a second ten years.

The Royal Naval Reserve is too costly, and could not be relied on, except for home defence, and the real reserve must be an overflow from the Navy.

The Naval Artillery Volunteers are well adapted to form a torpedo defence corps.

A point which deserves to be remarked is the number of men on board an English man-of-war who cannot be utilized in the event of casualties at the guns. We are inundated with cooks, stewards, and servants, who are only available as carriers, and that under a rigid surveillance.

We should have a first and second reserve, the first to consist of the Coast Guard, and men who have served ten years in the Navy. The second reserve to consist of the Royal Naval Reserve and Royal Naval Artillery Volunteers. The former reserve to man ships, and the latter to be employed in coast defence.

As to colonial and home defence, the Essay claims that each colony having self-government should provide some measure of self-protection.

We should defend a limited number of well-defined points, rather than attempt an all-round defence. Earthworks should form part of the system of defence, to be supplemented by vessels and torpedoes. The vessels should be floating fortresses, and gunboats carrying one heavy gun.

But with a Navy powerful enough to blockade an enemy's ports, so as to prevent him issuing forth to make a descent on your coasts, you have already an almost perfect defence.

Submarine defence is a necessity for our harbours and the mouths of rivers.

Summary.

The great questions raised for discussion by these Essays appear to be the following:—

- (1.) The amount of reliance which may be safely placed on steam propulsion, and on depôts for the supply of coal.
- (2.) The best means of protecting these depôts.
- (3.) The dangers to which our Naval Empire is exposed: invasion, blockade, isolated attacks on home and colonial sea-ports, the ravages of "Alabama," the cutting of our lines of communication, the dangers to our carrying trade involved in the temptations offered by the Declaration of Paris.
- (4.) The old question of turret and broadside.
- (5.) The newer question of the relative value of beam and end-on fire.
- (6.) The question whether many light guns or few heavy guns should form the armament.
- (7.) Whether ships should be armed to fight their own or other classes.
- (8.) Whether is the gun or the armour nearer its final limit of strength for a given weight and space.
- (9.) The relative value of the ram.
- (10.) The relative values of the spar, the Harvey, and the Whitehead torpedo.
- (11.) The entry and training of Officers and men.
- (12.) The provision and duties of reserves.
- (13.) The employment of Naval Volunteer Corps.
- (14.) Canvas or steam.
- (15.) The classification of our men-of-war.

THE CHAIRMAN: Gentlemen, I believe it is usual for the Chairman on these occasions to open the proceedings by a few remarks upon the subject to which we are about to give our attention; following that custom, I beg to say I feel great pleasure in acceding to the request which I had the honour of receiving, that I would preside at this discussion, and, Gentlemen, I do not believe that you could

have selected any Chairman who would enter into our proceedings to-day with a more sincere interest than I do. The subject of the Essay has at this moment unusual claims upon our attention. I find it thus described: "Great Britain's "Maritime Power; how best developed as regards Fighting Ships; Protection of Commerce; Naval, Volunteer or Supplemental Force; Colonial and Home Defence." I think every one here will agree with me that in a national point of view, it would be very difficult to select any subject of greater national importance than this. For these reasons I highly appreciate the valuable system of this Institution of granting a gold medal every year for essays on subjects which are germane to our military and naval position. It is a very admirable custom, and likely to produce very good effects. I think it is impossible that the medal could have been awarded to any subject of greater interest than that which I have just described. And I must congratulate this Institution on the able papers¹ which have been written, and I must specially be allowed to congratulate Captain Colomb, who is the successful candidate. As far as I have been able to study the four Essays which are now before us, they are such as to do great credit to the Officers who wrote them;² and I think we cannot fail to take notice of the fact that the second in order, so far as they are before me—and I think I shall not be unfair if I say the second in merit—is written by Commander Noel, who was the successful candidate upon the last occasion of the naval prize two years ago. I must not detain you by longer preliminary remarks. I hold in my hand a *précis* (as it appears to me, extremely well done) of each of the four Essays, and at the end there is a summary of the various points raised in them. It states, "The great questions raised for discussion by these Essays appear to be the following," and then follow thirteen heads. But I hope I shall not be considered guilty of presumption if I venture, on looking over these thirteen heads of the summary, to add two more; the first is the great question of "canvas or steam," to what extent our men-of-war are to be propelled either wholly by one or wholly by the other, or in what proportion are both to be resorted to. This subject is touched of course very naturally in the body of these Essays, and therefore, I think it ought to be mentioned in the summary. The other question is, I think, scarcely less important, "The question of the classification of our men-of-war." I see that in the body of these Essays this is a subject very naturally discussed, and with this remarkable result, that I observe no two of the writers of these Essays quite agree with each other. It is very important we should understand what is to be the classification of our men-of-war hereafter, and therefore, I hope I have not been at all presumptuous in adding those two questions as subjects for debate. With these few remarks I will at once invite the expression of opinion upon the papers before us. I may perhaps remind you of the rule which limits speakers on these occasions to ten minutes.

Captain W. DAWSON, R.N.: My Lord, I do not feel myself capable of discussing four Essays and fifteen subjects in ten minutes, and I must appeal to the meeting as I proceed, whether it may not be found proper to alter the rule, as has been done at preceding discussions of an important nature like this. I join heartily with Lord Hampton in congratulating the Institution on having brought into public existence four very valuable Essays; but, limited as we are to time for discussing them, I shall confine my remarks chiefly to the Prize Essay. We have laid before us in that talented composition, on broad comprehensive lines, a most statesmanlike view of the maritime policy which should guide us in defending our empire of the seas. That empire is not merely the British Islands, not merely the Colonies connected with the British Islands, but it is the ocean highways, and that great and growing commerce which proceeds from one to the other, without which this little island would soon sink into insignificance. When we once grasp that great imperial principle, we then have brought before us most convincingly and clearly in this invaluable Essay, what are the main points to be defended in order to protect that empire of the seas which has come down to us from our immediate forefathers.

¹ The essay by Commander Collingwood Selby, though not recommended for publication, was honourably mentioned by the referees.—Ed.

² Eleven essays were sent in in competition for the gold medal.—Ed.

Captain Colomb has placed these points before us very clearly and exhaustively. I am prepared to accept these broad imperial principles of maritime policy on the whole, but exception may be taken to details; and I should like to ask for further information on some minor points. One of the questions which I would ask for the sake of information is as to the basis on which the proposed coal-carrying power of the ships is to be based. It is stated to be that of the ship steaming a certain number of knots for 2,000 or 3,000 miles, and then steaming at the same rate back again. I suppose the object of a ship going that distance to a point midway between two depôts is not merely that she should steam back again, but that she should do something in the interval between her arriving at and leaving the mid-ocean point; in other words, that she should perform a six or a twelve months' cruise. I want to know what is to be her motor power in that interval of six or twelve months between her arrival and departure from the mid-ocean point. I have no doubt that there is some simple answer to this question, but I have not been able myself to master it. Then the question is naturally brought before us in connection with this imperial policy as to the substitution of steam only for auxiliary sails. It is impossible for anyone who looks forward impartially to the future, to the prospects of a great maritime war, not to see that the abolition of masts and sails, at least in our larger and in our smaller vessels, is inevitable. The whole tendency since the introduction of steam, has been towards its substitution for sail power. It is merely a question of time and of circumstances. Those young Officers I see around me, who are looking forward to a professional future which is denied to me, are, no doubt, looking forward to seasons of national struggles for existence in which actions must be fought with "foemen worthy of our steel," and they wish to hasten the time when they shall have the most effective weapons of offence. Naturally, however, we older Officers, who will not share in the coming struggles at sea, do not like to have the reminiscences of our past taken away. I think we cannot, however, but see that when the time of active service against an equal foe comes, men-of-war's men will be only too thankful to get rid of every rope and mast which is likely to foul their screws.

There is one point in Captain Colomb's invaluable Essay in which I think he has fallen into an inaccuracy. Those who have had the privilege of being taught by Captain Colomb, in this Institute, from time to time, must have remarked how extremely accurate he is in all his statements. I am therefore all the more surprised to find a statement with which I cannot agree as a true rendering of contemporary history. As I understand Captain Colomb's paper, he says, in effect, that at some recent period, the naval authorities took it into their heads to adopt a line of policy for the protection of our empire of the seas by the defence of the coasts of these islands, which Captain Colomb justly deems short-sighted, and, that in consequence of having adopted that short-sighted policy, they intentionally built, at an expense of several millions of money, a certain class of ships (unseaworthy) for the defence of our stormy coasts; whereas, such ships are the least capable of performing coast defence duties in stormy seas of any ships in the British Navy. Those ships were subsequently labelled "Coast Defence Ships." Now my memory of the circumstances is quite different. My authority on the subject is not only the statements in the public newspapers, before these ships were built; but also a paper read by the present Director of Naval Construction, before the "Glatton" touched water. My remembrance of those rather unprophectic utterances is, that the "Glatton" was intended to be built to fulfil exactly the maritime policy which Captain Colomb indicates, namely, to steam into the middle of the Atlantic, at a certain speed, carrying adequate coals, and to there fight an action, and then steam straight back again; but when the "Glatton" was launched, she and her consorts were found to be unseaworthy, and incapable of keeping the seas, except in calm weather; and because it was not looked upon as a proper and respectable thing to put them in the Navy List as "ships that won't swim," they invented a new name for unseaworthiness, namely, "Coast Defence Ships." I would ask any sane man if there is any sane seaman, who would knowingly construct ships that are unseaworthy, in order to defend the stormy coasts of Great Britain.

Then again, I may be told, that these ships are not coast defence ships, but that they were intentionally built, in order that they might be more efficient

as "harbour defence ships." Is there any seaman who would think of specially selecting for the defence of the entrance to the Thames or the Mersey, the Tyne or the Humber, vessels that draw twenty feet of water? I appeal to my friend, Commander Noel, who proposed a 10,000-ton coast defence ship, if he was placed in a position of command, for the purpose of defending the flats at the entrance of the Thames, against a hostile fleet, which would he prefer, a 10,000-ton ship, drawing 26 feet of water, which could not move from her anchorage, except at high water, and then, with half-a-dozen pilots and tug-vessels looking out upon her bows and stern and on all sides? Or whether he would not prefer to have fifty 200-ton flat-bottomed gunboats, which would pass over any of the flats, in any direction, at high water, trusting to their obscurity and to the shoals, for safety from large ships.

If a dozen of such little vessels did come to grief, Commander Noel would only lose a fourth of his armament. It is a matter of common sense, that ships that won't swim in all weathers, are not specially good for coast defence, and that ships drawing twenty feet of water are not essentially the best for the defence of our small and shallow harbours. I may be told that these vessels are not unseaworthy, because, in the month of June, they are sent a few miles outside deep-water harbours, with a squadron of "nurses," provided with boats to pick up their crews, and under one of the most careful Admirals of the Fleet, who would take care that if the barometer falls, they should be sent away from the coast they are to defend, into one of the ports near at hand. I would remind the meeting that one of these "coast defence ships" was, on one occasion, sent from Plymouth to Cork; the Admiral being an old-fashioned Officer, who thought ships were built to swim, looked very carefully at the barometer, and sent the coast defence ship out of port, but without a "nurse." Now, when the Americans sent the original "monitor" from port to port, they sent a "nurse" with her, and when an ordinary breeze sprang up off Cape Hatteras, the "nurse" sent her open boats, and withdrew the crew, who were, of course, quite safe in open boats, and let the monitor go to the bottom.

The bottom of the sea seems the natural destination of all ironclads, when they touch anything harder than water; but for the vessels we are now discussing, the ordinary waves of the sea suffice to send them to the bottom.

The English Admiral did not send a "nurse" to take care of the English crew of the English coast defence ship, when she ventured from Plymouth to Cork, and the result was, that when a breeze sprang up on the English coast, its gallant defenders very nearly went to the bottom. Instead of continuing the passage to Cork, the coast defence ship put back into port, and the Captain reported, that it was only by a merciful interposition of Providence that he and his crew were not at the bottom of the sea. Whatever else these ships are, they have no special fitness for the defence of stormy coasts, or of shallow harbours. I don't think, therefore, they could have been designed for such purposes.

Turning from this question of imperial policy, to the question of ships, I find that Captain Colomb has given us a rough sketch of an ironclad vessel, which he calls the "Outrageous." Now, at the outset, I venture to say that Captain Colomb does not put himself forward as a naval architect. He simply puts before us a rough sketch of a possible ship, illustrating general principles.

Those who examine that rough sketch carefully, will find a combination of most valuable suggestions, which ought not to be passed lightly over, but should receive very careful consideration. There are, however, some details suggested in that sketch of an ironclad ship, which are open to debate, and there is one especially, which, perhaps, some present may look upon as outrageous, in more senses than one. I allude to the unarmoured belt. Passing over that debateable point, there are several most valuable suggestions. One of those excellent recommendations, is that in which armour is sacrificed in order to get increased armament. In the day of battle, one hundred tons additional ordnance will be of far more value than one hundred tons of additional armour. I am thankful to see, that not only Captain Colomb, but the other essayists have all laid great stress on increasing the offensive powers of existing ships. What, I would venture to ask this assembly, is it that makes the lion the king of the forest? Is it the thickness of his hide? or is it not

the power of his teeth, and the force of his claws? what is it that made the "Amethyst" the useless ship she was for three hours in the presence of a Peruvian vessel? Was it the thinness of her sides? why her sides were thick enough to resist the concussions of the air, which was all they had to endure. What made her so helpless was, that she had no offensive weapons by which she could do injury to such a foe. She had neither ram, nor torpedo, nor a gun worth anything in such a contest; consequently, this defender of British interests in the Pacific was quite helpless. The foundation of this error is simply a matter of false policy. A notion is prevalent, that ships of a given class are only to fight with vessels of the same class; and are not to take advantage of the points in which small vessels are superior to large ones. That is an utter absurdity. What is the use of building a ship like the "Inflexible" if she is only to fight a vessel of her own class? Why she would be the most useless ship in the Navy, if she was incapable of fighting vessels of other classes, because it is most unlikely that she will ever exchange shots with a vessel of her own special class. A British ship, sent out to the ends of the earth, to protect British interests, must be prepared to do injury in some way to whatever vessel she is unable to run away from. If she has swift legs, she can run away. BUT if she has not got swift legs (and British ships in former days as compared with foreigners, had very bad legs, and could not always run away), then she must either strike or fight. The only time Lord Nelson tried to run away he found great difficulty, because his ship could not run fast enough, and he only escaped by getting behind some friendly rocks.

Should a superior squadron of smaller British vessels meet a single ship of a heavier class of some other nation, ought they not to be able to leave their mark on the larger vessel?

If a single British ship meets a hostile squadron, or a superior single ship, and cannot run away, what is she to do? If she has not got legs to run away, she must either strike her flag, or if she has weapons capable of inflicting injury, she must fight; and she must not, in such a case, ask any questions as to the thickness of the sides of the enemy.

Where there is no alternative but to fight or strike, I hope the British Navy will not forget Sir Richard Grenville's single ship fighting 50 sail of Spain, and that it is not come to the disgraceful pitch, that there is any Officer that, if provided with a beak, a torpedo, or an armour-piercing gun, would strike his flag when opposed by a vessel heavier than his own, without trying the chances of war in an endeavour to run his beak under her armour, to aim a torpedo at her bottom, or to plant a few shots below the water line at the ends. In any fight that takes place between a short gunboat provided with a beak, and a long ironclad, let it be known to all young Officers who have command of such small vessels, that they have a very fair chance for life in such an unequal contest. In the case of ramming, the smaller and quicker vessel will have more chance of hitting with her beak than the longer vessel.

Though I do say that the British flag is equivalent to several inches of armour, I do not mean to say that the smaller vessel is to seek a combat; but if the combat is forced upon her, the British vessel should have the means given her to speak loudly and forcibly, in the name of Great Britain, with all the ram, torpedo, and gun-power suitable to her tonnage. The great mistake in the armament of our ships is not only that the weight of ordnance carried is too small in proportion to tonnage, but that the individual guns are not sufficiently varied to enable them to fight vessels of dissimilar classes.

I have always advocated mixed armaments. Each ship of war, should not only carry a few large guns, which will penetrate the thicker-sided vessels; but also a number of smaller, and it may be, less protected guns, for the purpose of penetrating the thinner-sided vessels. If the "Inflexible" be attacked by a number of thin-sided vessels carrying heavy ordnance, she ought to be able to defend herself against those vessels which actually exist and might readily be multiplied, quite as much as against another "Inflexible," of which very few exist, or can be quickly produced.

But the "Inflexible" is rendered incapable of adding smaller and partially protected guns, of say 12 tons weight to her offensive power, by the adoption of turrets which limit the offensive force to four guns, the value of which depends upon four pairs of eyes. If she was a broadside vessel, she would not only be able to carry these

four 80-ton guns on each side, but by throwing off 200 tons of armour, she might also carry a very large number of smaller ordnance outside her armoured part. These guns would make her additionally powerful in resisting any combined attack made upon her by a squadron of smaller vessels, or when taking part in a bombardment.

There is another point, in the "Outrageous," which ought not to be overlooked, and that is the principle of duality, a principle of very vital importance, upon which I need not further dilate, but will simply call attention to its great value. I regret to observe that the essayists condemn entirely the Harvey towing torpedo. I always hoped that the Harvey towing torpedo might be found a very useful weapon for defensive purposes, to defend an ironclad under weigh against an attack by a ram. If there have been any experimental practice in seagoing squadrons, or any further experience in towing torpedoes at sea in recent years, which disproves my anticipations of its value as a defensive weapon, I can quite understand the essayist coming to conclusions adverse to its use; but I have no recent experimental knowledge or experience on the matter; and in former years I spoke mere opinions formed on slender experiments made in the early period of the Harvey experience.

Commander CURTIS: I think both Captain Colomb and Lieutenant Haye propose to do away with sail power. Captain Colomb admits a small portion of canvas, about half what we have at present. I think we are all agreed that in such seas as the Baltic and the Mediterranean, ironclads of the first class should do away with canvas altogether, and any action they might fight may be fought by lowering their torpedo boats (which in future will fight in conjunction with the ironclad ships), and they will have their orders to torpedo when opportunity occurs. I think the large ships will have quite enough to do with looking after and ramming one another while the torpedo boats will take all favourable opportunities to make their own particular attack. Lieutenant Wilnot says his ship the "Zealous" covered 30,000 miles with 1,600 tons of coal. I think myself the efficiency of the ship depends very much upon the ability she will contain within herself with regard to power of locomotion. In event of coal or machinery failing, she can fall back upon her sail-power. I think our Navy should have recruited from the Mercantile Marine, bargemen and those who get their living on the water, on our coasts, &c. I see one of the questions for discussion is how best to preserve the pre-eminence of naval power by recruiting, and what force we should recruit from. I may say that from my experience of ten or twelve years as a First Lieutenant, of the lads we get from reformatories, they do not turn out all that we could desire, and we must look for our valuable recruits to the seafaring population. With regard to the rig of our ships, I think they should be square rigged forward, and square main topsail, &c., similar to despatch boat "Vigilant," rigged in 1855, or gunboat. The spars should be duplicates of one another, so that the ship would not require so many spars; and as actions would be fought under steam, I do not see the necessity of having double stays and double ropes. I hope Captain Colomb will modify his idea as to the stability of ships, *steadiness of platform*, I should prefer to call it, because I only know two things or nautical terms, that is "stiffness," and "crankness." The difficulties of the Cleopatra Needle ship arose I think from having the centre of gravity and the meta-centre together as nearly as possible. I spoke to Mr. Matthews, the second in command of that vessel; he said "she was very steady; we thought we were never coming up again, inasmuch as 'she had not reserve power or very little within herself to right herself.' If you bring the meta-centre and the centre of gravity close together, the ship loses her stiffness and you get a greater lever and shorten the fulcrum, and the pressure of canvas has greater power to capsize the ship. The "Stability of Platform Theory," is fallacious altogether; the ship will not right herself so quickly: the ship may appear steady, but if you unnerve the seamen and Officers of the ship, you lose half the battle; they do not put confidence in a certain class of ships. A sphere, cask, or flat raft are the steadiest forms for flotation, without rolling motion: "but," they have no stiffness to speak of as such.

I recollect the case of the "Hecate" coming from Alexandria to Malta with the Indian mails on board in about 1844; she was becalmed, she burnt her coals out and they had to burn the midshipmen's chests, spare spars, and everything on board of her. I do think there is a time coming when our nation will make use of improve-

ments. I must say if in an open fire I burn a hundredweight of coal with only 14 lbs. of residue, that when they will combine more oxygen with the carburetted hydrogen gas of the coal, that is to say with the down-draft (and this is to be done I am certain), they will burn not only the coal but the smoke and they will not be seen by the enemy, and the ships will be able to carry enough coal, as it will be all consumed, except that which is not combustible.

I think Lieutenant Wilnot has hit upon the right class of vessel, though he has rather shortened her too much. I say a vessel should not be more than four and a half times the length of her beam, and she should be a semi-spheroid to water line. If I want to embrace an oblong rectangular, a semi-spheroid will give the least resistance in the water. I went a little while ago to look at the "Monarch," and I must say as a piece of naval architecture I could not understand it, because three-fourths of the ship was mere friction. Three-fourths of her sides were perfect walls. If any midshipman was going to tow a spar he would tow it big-end forwards and not the tapered end forwards, so that I think our present ships are not what should be desired. I think also all our ships should be double enders, if they do not have dual ships, and I believe the time is coming when we shall have dual ships. However, with the single ships I should recommend bean-cod bows or ends, and that the ram should be an independent adjunct to the ship, with a spring piston head or compound spring and hydraulic ram to strike 1,000 tons blow. The ship proper should have an up-and-down stem, and stern with ram affixed, bean-cod ends, four screws and rudders and two circular turrets, and if you place two circular turrets within a fort at either end you will get an all-round fire with the exception of 42 degrees. I do hope that Captain Colomb will see his way not to persevere with his demand for this steadiness or stability of platform, as it is termed.¹

Admiral HAMILTON, C.B. : In the first place, my Lord, I should wish very much to second the compliments and congratulations with which you commenced your speech, to the Council of this Institution for the great success that has attended the

¹ Marines work well at Ascension, why not garrison our coal depôts with the corps ? In 1854 we could not get seamen for the "Royal Albert" fitting out, and Marines and Marine Artillerymen fitted all the gun gear. A large body of Coast Guardsmen were drafted on board previous to going to the Crimea, excepting the long-shore old men, and Civil Service men ; they were all that could be desired, enduring heavy and steady work—no bad language ; they set an example to the younger men, which benefited them during the rest of the commission ; a more united set of Officers and men never existed—comfort with efficiency—I have never seen her like since.

I never see any comparison in the House of Commons, touching the relative expenditure in guarding our commerce and our Colonies. The increased cost of our Army and Navy, I venture to say, has not increased in the same relative proportion to colonial and floating wealth to guard.

Our experience of vessels ramming as at present constructed is—"Vanguard" and "Iron Duke," the German ironclads, "Grosser Kurfürst," and "Konig "Wilhelm," and some time ago a gunboat in the Channel : all the rammers were more or less damaged, proving that the present construction is faulty ; they should be able to give a blow sufficient to stave the ribs of an enemy without turning their ram athwart ships, or splitting it up.

The ram of the "Konig Wilhelm" has certainly proved most effectually destructive, but, at the same time, it has demonstrated the weakness of its own construction. Viewed from the bottom of the dock, the ram and portion of the stem itself are seen to be twisted over to the port side at an angle of 45 deg., and the bottom plating and the armour above gapes wide open from within a few feet of the keel to the upper-deck, all the rivets (tapped rivets) which secured them to the stem being, in shipbuilding parlance, sheared—that is, the heads drawn through the holes or broken off short. The armour-plating terminating at the armour-shelf has left the stem by shearing off the rivets, and the stem itself is broken short off at the armour-shelf, and also at its scarf, some six feet below the ram.—JAMES D. CURTIS, Commander, R.N.

granting a medal for the Prize Essay. The Prize Essay is a most valuable Essay, and I have no hesitation in saying we may all gain some practical information from it and the three other essays. I do not agree with the writer on several points, and, as you have pointed out, the writers differ materially among themselves; but in addition to these we are given to understand that seven other Officers sent in essays, and everyone who has ever written a paper or an essay knows very well that, allowing that they succeed in imparting no information to those who read them, one thing is certain, that no one writes papers who does not himself gain a considerable amount of information from so doing. I therefore say every one of those Officers who have written those essays are more valuable Officers and better public servants after having written them, than they would have been if they had not done so. To those who have been unsuccessful I would only say, "try again." These papers are very widely read through the Journal of the Institution, and they will diffuse information throughout the whole of the Services. I may say that the newest idea I have gained is from that very valuable portion of Captain Colomb's essay, in which he deals with the protection of our commerce, which is much more easily protected than I had previously been aware of. That the referees have made a wise selection in bestowing the prize upon Captain Colomb, I think all will agree. Of course Captain Colomb has one advantage over his competitors; he is older, he has had the advantage of having held responsible commands, therefore he has more experience. He has served on several Admiralty Committees; therefore he has had a certain amount of knowledge of the civil administration of the Admiralty which the others did not possess. And owing to this he has recognised two facts which they do not recognise. The first is the existence of that very obnoxious individual the Chancellor of the Exchequer! Now I have no doubt our noble Chairman will confirm me when I say, by the tight grip he has on the national purse-strings he shuts up a good many beneficent plans and ideas of the Secretary of State for War and of the First Lords of the Admiralty with regard to the Services they represent. The next point he recognised is, that owing to our peculiar system of government, our changes of administration are very great and rapid and no one man is long enough in power to impress his character on the Service. Those two important facts are very much to be considered—his is a practical essay, whereas in many respects the others are theoretical. In my opinion both Captain Colomb and Captain Noel give a great deal too much time and attention to the details of ship building, and far beyond the province of naval Officers, and encroaching on that of the naval architect. I remember at one of the dockyards I was connected with, the Chief Constructor had an idea that the authorities were going to call on him for a plan of an ironclad. In conjunction with his chief draughtsman he got out what appeared an excellent idea. When, however, he went thoroughly into the question of weights he reduced one thing and then another, until he came to the conclusion that the Chief Constructor of a dockyard did not possess sufficient data to design that complicated structure, an ironclad. That is the only part of his essay in which, I think, Captain Colomb has not taken a practical view. We have had a very able summary placed before us, pointing out the questions for discussion, and the first question is "The amount of reliance which may be safely placed upon steam propulsion and on depôts for the supply of coal?" I am one of those who say that we cannot do without sail at present, whatever the future may bring forth. Engines will fail, boilers will fail, and in the commencement of a war, coal depôts will fail; therefore we should not place too much reliance on steam power alone, but sail power should be the auxiliary. The next question is "The best means of protecting these depôts?" That, in my opinion, is best done by keeping up our naval supremacy, which will prevent any Power concentrating a large force and taking them: at the same time they must be slightly garrisoned in order to keep off the attack of privateers or of solitary cruisers. Then as to the third question—the dangers to which our naval empire is exposed—I think Captain Colomb has answered that very conclusively in the part of his essay which dwells upon the protection of our commercial routes, that there is no occasion to say anything more. Next comes the "old question of turret and broadside," and in this there is great difference of opinion. My idea is, with Admiral Porter, that you must have your broadside ships for rapidity of fire to keep down that of the enemy, and at the same time you require heavy monitor and turret ships, where

men can fire perfectly under shelter, to implant the heavy blow. Therefore I go in for mixed armaments. The next question is whether ships should be armed to fight their own or other classes. I certainly think that vessels should fight with their own class, but at the same time if a vessel falls in with a ship of another class she must fight her. In the old days the classes were kept pretty distinct, but still we sometimes find that frigates fought line-of-battle ships; and there is the case of Lord Cochrane in the little "Speedy" brig and the Spanish frigate he captured; but these were exceptions to the rule. Whether the gun or the armour is nearer its final limit of strength, is a question for civil engineers. Then comes the question as to the age of the entry and the training of Officers and men. And on that point I think Captain Noel's paper is very good indeed. I have had opportunities of comparing boys from the training ships at Portland, Plymouth, and Falmouth, entered at the early age, with boys entered in the coast guard ship between 16½ or 18 years of age, under precisely the same system as the younger boys in training ships. On one occasion going on board I saw some boys on the gangway who drilled so admirably that I asked the Officer which of the training ships they came from (we then had boys from "Boscawen," "Implacable," "Impregnable," and "Ganges," on board besides the older boys): he said (to my surprise), "They are our own first-class boys" "that we have raised, they have been about three months in the ship." Those boys were 1½ to 2 years older than the boys coming from the training ships. The captains of the sea-going ships, to whom these boys were sent, were ordered to report upon them, and the report was that these older boys, although they had not been brought up in the training ships, were superior to the younger boys. Their instructors from the training ships also considered them more attentive and zealous. This I think will mise the question whether it will not be better to enter naval cadets at 15 rather than at 13. The old naval coast volunteers were supposed to be fishermen, boatmen, and men of that sort who would protect the coast. Unfortunately that part of the service got most frightfully abused. I remember in the "Achilles" having 60 of these men upon the quarter-deck and asking them where they came from, and I found that the majority were farm labourers, and out of these 60 men there were not four that knew starboard from port, and yet these men were naval volunteers. The result was, these men instead of being drilled at the guns were employed to do all the dirty work of the ship. Under a proper system, that is a corps which might be productive of the greatest advantage, for you might get thousands of men round our coasts to join it, who would be a great source of strength to us. There are one or two points of detail that I should like to mention. Lieutenant Haye talks very much about the danger of the screw being fouled. Theoretically there is no doubt that it is so. However, in the American civil war, Admiral Farragut went up the rivers repeatedly and attacked forts; he always had topsail, jib, spanker, and fore-sail bent. Therefore I need not say he had a considerable amount of top hamper, but no single instance occurred that I know of where an American ship was disabled in action by her screw being fouled. On one occasion a ram was sent down to attack eight wooden gunboats, and two of those gunboats were specially told off to put nets round her stern and foul her screw, but they did not succeed. Therefore, judging from past experience, I think fouling a screw in action will not occur very often. Lieutenant Haye recommended the Turbine. No doubt the turbine is theoretically the best motive power for a man-of-war—practically speaking it is not a success at present. There is one remark in Commander Noel's essay against which I particularly wish to enter my strong protest, and that is where he says Officers of the present day are not the seamen they were. It is 20 years ago since our noble Chairman gave me my first command, and during that time I have had under my orders a good many lieutenants, and I can only say the lieutenants of the present day are quite equal to those who were with me 20 years ago. Captain Colomb was with me a short time ago in the "Achilles" in 1873. Admiral Randolph had his flag on board, and on leaving, Admiral Randolph complimented the lieutenants on the efficient manner in which they performed their duty. The lieutenants of the present day are in my opinion quite equal to the old ones. Another idea to which I dissent is the abolition of gunnery lieutenants and that every navigating lieutenant ought to be a gunnery lieutenant and *vice versa*, but I think we should have one man for navigation and another man for gunnery, according to the natural

turn of mind. Each man has his own particular talent, and he should do that particular work, and we should not put the round peg in the square hole.

Captain LONG, R.N. : I should like to make one or two remarks, from the fact that naval Officers who have served on foreign stations ought, I think, to speak their minds on these occasions. I recognise to the full the great value of Captain Colomb's essay, and only want to say a word on one or two points. The first point is that the great difference between naval supremacy abroad at the present day and formerly is the existence of telegraphic communication. That has been brought home to me in a very marked way on many occasions, and it is more valuable to have a powerful vessel that can go rapidly from your telegraphic centre, performing the service you require, and come back rapidly, ready to perform another service, than to have a number of small vessels that go blundering about and are never heard of for months. We have heard a great deal of "bases," and of course everybody recognises the necessity of them. There are, however, one or two cases where our bases are store ships, and there I think they should be sea-going store ships. With regard to the western trade routes, the construction of a canal through the Isthmus of Panama, which I have no doubt will be done before very long, will materially modify those western routes. I do not propose to make any remarks about anything with regard to which, I feel satisfied, the authorities who have the governing of our naval affairs are fully alive, therefore, that will cause me to leave out a very large proportion of subjects which I otherwise should have remarked upon, because our naval authorities are very successful in those things; but with regard to the ideal war ship I would remark first as to her mobility, in which I include "manœuvring power" as well as "speed." I think that is by far the most important quality in any ship. With regard to compound engines, that appears to be a point open to question. I am happy to say we have now got vertical cylinders, which are much superior to horizontal ones; the trial of the "Nelson" and "Northampton" will throw light on this subject. With respect to the engines I have observed with very great regret that Mr. Loftus Perkins's system is not to be tested. In Mr. King's book he tells us, page 116, that it was to be tested, but it appears no notice is taken of it in the estimates. It seems to me to be a very valuable system. And even though its success be doubtful, it should be tested, for it promises to reduce the consumption of coal by one-half, and that is a matter of vital importance. With regard to Captain Colomb's opinions about reducing sail power, I entirely agree with him in principle, with this slight modification, that I should retain at least two yards on the foremast, those I should stow in crutches on deck when not required aloft. The next point about the ideal war ship appears to be her offensive powers. On that point I really do not feel that I can speak with any authority whatever, but I should be inclined to add submarine tubes for the discharge of Whiteheads, which are known to be very formidable weapons. And I think submarine tubes are more valuable than above-water tubes. Of course if you see the Whitehead when it is fired, that gives you a better chance, but if you do not see it when it is fired, you cannot find out that it has been fired from two to five seconds out of the 30 seconds which would be allowed you to avoid it. A single-screw ship would not have a chance to avoid it at a distance of 300 yards, but a double-screw ship might avoid it. I am glad to see Captain Colomb advocates rams for all vessels. With regard to the guns, I would only wish to endorse what Captain Dawson said about the most powerful and hardest hitting guns being put on our ships. I should be very sorry to be in any ship that had not as many guns as she could carry with which I could hurt any adversary. Then I come to the defensive power. Now Captain Dawson very justly remarked it is not the thickness of her armour that makes her powerful; at the same time, unless you have a well defended ship, you will find her offensive power of very little use. With regard to the dual principle and watertight compartments, I think they are very valuable; but are these precautions sufficient against Whiteheads? I do not think they are, without external protection. I believe the general opinion abroad is that external protection would be useful in rivers and inland seas, but that it cannot be made use of in the open ocean with the ship going at high speed. If that is the case, I think your fleet would be very easily destroyed by a much smaller one, but I do not see why it should be the case. I cannot help thinking our architects are competent to give us some system of submarine outriggers to enable you to carry your nets in action, so as to avoid the attacks of the smaller vessels,

which appears to be the only point in which the large ship is not superior to every other sort of ship. The Whitehead torpedo of course can be launched from a vessel of small size and much less costly than an ironclad which it is attacking, and to whose artillery the Whitehead vessel may be made invulnerable, and although we are told two blows would not sink a vessel, yet at the same time two blows might render her unmanageable. Then if nets outside the ship are required, the most important thing would be the protection of her screw. I happened on one occasion to be on a sloop; we were steaming with one engine and her screw was fouled by an inch-and-a-half rope attached to the end of a towing hawser. We could not start the screw without having headway on, and so we were towed out of the anchorage and started the screw. Unfortunately the small rope that was left at the end of the hawser had got round the bases of the screw and stopped it by wedging it. It was rather curious to think that an inch-and-a-half rope should stop the screw of a ship like that. I have lately been engaged in Rochester creek, and I can call to mind four different occasions on which the steam launches have been rendered useless, owing to the fouling of their screws by ropes. I therefore think the protection of a screw is a matter of great importance. Lastly, with regard to submarine projectiles we must remember they are in their infancy.¹

Admiral HAMILTON: I am well aware how the screw is fouled. An inch-and-a-half rope did the same for me in a paddle steamer. I was only saying how rare it is in actual warfare. In the whole annals of American history there was not a single case of a vessel being stopped from fighting by her screw being fouled.

Commander CUSTANCE: I wish to offer a few remarks upon two subjects: one of armament and the other of training of men. I am encouraged to do this by some remarks of Captain Colomb, R.N. I have not had the opportunity of reading Commander Noel's Essay, but I gather that in his opinion the present system of training men is good. It will be remembered by those who have read Captain Colomb's Essay that he compares the "Inflexible" with the "Gamma;" his conclusion I quite agree with, but I think his argument might be improved upon. He considers the "Inflexible" as one ship, and I think there he is a little wrong, because she is a "fleet" ship and ought to be considered as one of a fleet. We must therefore consider this: take some given sum of money, say 3,000,000*l.*, what is the best squadron we can make for three millions of money? It is not too much, because the Italians are investing 2,500,000*l.* on four ships. What is the best squadron for 3,000,000*l.*? It will produce 6 "Inflexibles," or it will produce 120 "Gammass." Now which is most powerful? I will not answer this directly but will say that there are two distinct ways in which a squadron may be given superiority; it may have superiority of numbers or of individual excellence; it cannot have both. The same sum of money utilized by the same brain cannot give superiority of numbers and superiority of individual excellence.² The "Inflexible" represents individual superiority, the "Gamma" represents the superiority due to numbers. This question has been answered by the Admiralty; they have had to consider whether they would build 6 "Inflexibles" or a larger number of slightly smaller ships. Instead of going to

¹ With regard to Lieutenant Haye's remarks about clearing, lifting and non-lifting screws, I wish to point out that on the occasion I referred to, the screw could not be lifted, as the frame was wedged tight in the well.—L. LONG.

² Whichever superiority be given, whether it be that due to numbers or to individual excellence, the object is the same, viz., to enable the maximum to be concentrated on the decisive points. Bearing in mind that the object is to concentrate power, are there no disadvantages in *large* numbers or in *great* individual excellence? The objection to a large number of ships is that they are difficult to handle, that is to say, it is not easy to concentrate power. A smaller number of ships of greater individual superiority would have the advantage. On the other hand, a small number of ships of great individual excellence cannot be manœuvred with any more facility than a slightly larger number of individually weaker ships, and would be at a disadvantage in point of numbers. In the case of large numbers, individual superiority is of more importance than numbers; but in the case of great individual excellence, numbers are likely to beat individual superiority.

11,000 tons they have taken a displacement of 8,500 tons in the "Ajax," costing 350,000*l.*, which will give them for 3,000,000*l.* 9 ships. We therefore have 9 "Ajaxes" against 5 "Inflexibles," 9 rams, and 18 pairs of 38-ton guns against 6 rams and 12 pairs of 80-ton guns. The decision as to which is the best of these squadrons must be left to Officers who have commanded fleets. The Admiralty, who have greater experience than anybody else in the country, have decided that the 9 rams and 18 pairs of 38-ton guns are superior to the 6 rams and the 12 pairs of 80-ton guns. A French constructor, Monsieur Dislère, also places 8,000 tons as the maximum displacement to which it is likely we shall return.

I should now wish to pass to the armament of individual ships. Captain Colomb has proposed 12 25-ton guns for his first-class ship. In this question of armament, I think the difficulty of handling a considerable number of guns must be taken into account. There is a limit to the number which can be handled effectively. It is a question which should be decided by experiment, whether 12 guns, 6 a side, is not more than you can get the maximum number of hits out of. I should like to suggest that the trial might be, say whether the five 9-inch guns of the "Bellerophon" will not give as many hits as the eight 9-inch guns of the "Minotaur." I think the smoke and the difficulty of passing the orders along a long deck is very considerable. To give an example of the evil effects of smoke: some 15 years ago, I was in an action in a frigate, one of the few actions that have been fought by ships. She was a 35-ton gun frigate, 18 guns on the side. We were engaged and the captains of the after guns very rarely saw the batteries we were firing at, the smoke was so thick. They fired a round every three or four minutes perhaps. That was a case in my own experience. Of course 18 guns are many more than we have now to deal with, but still it shows that there is some cause for inquiry. I am also led to believe experiments have been carried out in the Italian fleet, which have shown that a ship carrying five guns a side only fired two guns out of the five. I have not all the conditions of what they were firing at, but this is another point to show that there is something in this. I do not think people have sufficiently realized what it is to engage at 10 or 12 knots.¹ I think the Officers of the "Shah" can tell you something about that. Passing now to electric firing, upon which so much money has been spent and which everybody talked so much about, the "Shah" fired an electric broadside at 300 yards at the "Huascar," but she never hit her, the broadside went 20 yards astern. The whole thing is so complicated, it is very questionable whether it will be of any use. All the practice which takes place is not to be relied upon. The broadside is laid for a particular distance and the ships always pass the target at that particular distance in practice. Now in action you cannot pass at your own particular distance, because there are two people who have to decide. You may have your broadside laid for 500 yards, and the other man for 200, and you cannot both pass at your proper distance, and if you do not pass at the distance for which you are laid the errors are very large. I should like to see this question settled by experiment; it never has been yet, as far as I am aware of. This view is also taken by several Officers with whom I have come in contact.

I should now wish to pass to the training question, which I gather from the *précis*, Commander Noel thinks very perfect. The *émeutes* we have had on one or two of the ships that have gone to sea lately, I think have shown that all is not quite right in the training establishment. The boys' training is all very well, but certainly not that of the men.² The great evil of it all is the gunnery ships; they appear to me to do an immense amount of damage, because they take nine-tenths of the best men away to one establishment, and leave all the troublesome ones in another. The young hands have nobody to look after them. It is an evil recognised by I may say countless Officers who have had to do with the training of the men in the home ports, and till you do away with these gunnery ships, you never can have the great body of the service properly trained and disciplined.

Captain VERNEY: My Lord, there are 13 headings, I see, to be discussed, and I

¹ When engaging at these high speeds, the dangerous interval is so short that even a short smoke interval may greatly interfere with hitting.

² *Fide* Papers read at the Institution by Captain J. C. Wilson, R.N., and the discussions thereon.—R. N. C.

have a good deal to say upon all of them ; I will, however, only now say a word upon the last two, viz., upon the question of the Reserves and Volunteers. I happened to have had lately a coastguard appointment, and I ought to know a little about the Reserves, for it fell to my duty to have to inspect the Royal Naval Reserve men. If this country should unhappily be involved in war, we are quite sure to call upon these men, and I am very glad to bear my testimony to this, that they will be found to be a first-rate body of men. I have had to inspect them frequently and sometimes under circumstances of some little aggravation to themselves, and I have had to inspect them when they have been under the drill of no very good tempered officers, and when I have known that there have been many things to make their drill a little uncomfortable to themselves, and I have the greatest admiration for their patience, their perseverance, the great trouble with which they have mastered their drill, coming from merchant ships with very little discipline, and during the month they have been under training they have come out remarkably well, and I am quite sure if we place our dependence upon them in the time of need we shall not be disappointed. I have also had something to do with seeing the Naval Volunteer Corps, particularly the one at Liverpool. They went to sea for 48 hours in the guardship. At the same time some of the coast guard were embarked, so I got hold of one or two of the coast guard and asked them how these Royal Naval Volunteers behaved at sea. Now who are these men ? Why, many of them are clerks in offices ; many of them come under the heading of what people popularly call "gentlemen," whatever that means, and many are people with soft hands and accustomed to wear kid gloves. The coast guard men told me that these men fell into their work like old blue-jackets, they flinched from nothing. They kept their messes in good order ; they were up in the morning. I heard that after their tea at five o'clock, one of them wanted to know when they were going to have dinner, and was a little astonished to hear they had had their dinner at 12. As to discipline they came well to the front and did their duty like men. I am sure this Institution is glad to hear the opinion of one Officer, whatever others may think. That is my experience of these two bodies of men. If the time of need suddenly arrives, we shall not be disappointed in these Naval Reserve men, and we shall have within call these large bodies of Naval Volunteers at the sea ports, and at some preconcerted signals I am sure we should get a fine body of fellows willing to undergo some description of hardship if they were suddenly embarked for a few days for any special service.

Admiral HAMILTON : I am glad to confirm what Captain Verney has said on that point. I have had the same experience he has had.

Captain SCOTT, R.N. : Although the noble Chairman pointed out some differences in the opinions of the essayists, there is a general concurrence amongst them as to the armament of ships, and they are, I think, pretty nearly agreed that the power of our ships wants further development, especially as regards the guns. With reference to this point, I will take the "Inflexible," a type of war ship with which the essayists appear *not* to be too well satisfied. She is of very large tonnage with four enormous guns, but with no reserve of heavy ordnance ; and is therefore wanting in that quality of principle for which Captain Colomb has so ably contended as essential in an ironclad's fitments. The "Inflexible" is likewise deficient in light guns, and is therefore inefficient as a cruiser. I think an ironclad that wants another vessel, or several small craft to protect her, cannot be considered an efficient war ship, and this brings me to another point, which Captain Colomb as well as others of the essayists have so ably brought out, which is, that all our vessels should be well adapted for foreign service or for service at a distance from our shores. Before putting before you the ground upon which I think you will agree that this is correct, I should like to point out that there is an error underlying the whole principle of our naval armaments, viz., that of increasing the defence at the expense of the power of attack. I believe in all our ironclads, from the "Inflexible" downwards, the due proportion of the power of attack is now being sacrificed to the defence, but the whole naval policy of our country has heretofore been and must continue to be one of "attack." Our power mainly consists in offensive warfare and *not* in remaining on the defensive. I therefore wish to point out, that all our turret vessels share equally with the "Inflexible" in deficiency of offensive power. They all have very few guns, and these are in many cases dependent upon machinery, which is

exceedingly difficult to keep in working order, which requires an engineer to manipulate, and which may break down at a critical moment. These vessels have neither supplemental heavy ordnance or small guns, so that they are dangerously exposed to the attacks of the smaller torpedo boats. The "Huascar's" combat really confirmed what had been taught us in the American war, that the armour in nearly all cases, kept out the shot of guns which were supposed to be able to penetrate it. We have, I think, been misled in this matter by our target firing, which is always at right angles. Such firing could scarcely ever happen at sea, where you could seldom get an enemy's ship so near as the target is from the gun at Shoeburyness, and hence the element of twist would largely affect the penetration, for it is the sharp spin that makes the shot stick to its work after striking; as the distance of flight increases, the rapidity of the shot's rotation lessens, and is in great measure lost at long ranges, and hence failure to penetrate, results even on the shot's striking at a right angle. I have been informed to-day that there is a very able article in "Fraser" on this subject. We know that in the action off Lissa of which it speaks, the shot did not penetrate the armour of the ships they were fired at. In the combat between the "Shah," supported by the "Amethyst," and the "Huascar," of which we know most of the details, there is on the one side, a small single-turreted vessel, a little over 1,000 tons, mounting only two old pattern guns of, I think, about 10½ tons weight each, but called 250-pounders. With these guns, however, she did nothing. The "Shah," on the other hand, had two 12½-ton guns of the newest pattern, and yet their shot failed to penetrate the "Huascar," a vessel of the earlier turret type and covered with between 4 and 4½ inch thickness of armour, and she was badly manned. Directly this action was known—I hope I am not wrong in referring to it as an illustration of how people come to different conclusions from the same facts—it was said in "the House," that an ironclad ought at once to be sent to the Pacific. But no notice was taken of the fact that the failure was in the gun-power. The "Triumph" and "Inflexible," and all that class of ironclads which were named as suitable for the Pacific, mount only the very same calibre guns as those of the "Shah," of 12½ tons weight; therefore such guns would not have been a bit more destructive in their effect, from being mounted in an ironclad covered with armour, 6 and 7 inches thick. I wish to bring clearly before you, that it was the guns, and not the absence of armour that occasioned this indecisive action, because we are still increasing the thickness of armour, rather than increasing the power of the guns. Captain Colomb has stated in his essay that the relative power of ships can only be fairly considered with reference to cost. This is a very important element; and if we thus measure the power of the vessels of the class I have just mentioned, they certainly fall short, for they only mount 12½-ton guns. I am perfectly aware that the "Triumph" class could mount 18-ton guns, and they should do so, but as yet they do not mount such ordnance. In the latter class, that of the "Nelson" and "Northampton," 12½-ton guns form their unprotected central battery, and small patches of armour cover the 18-ton guns mounted at the four corners of this battery. We are told that this arrangement will enable the crews of the 12½-ton guns to run under the shelter of the armour of the 18-ton guns when an enemy's ship is passing; but how is it possible that such a manœuvre could be effected in action? But 12½-ton guns are not sufficiently powerful, as shown by the "Shah's" firing, and therefore I think that these partially armoured vessels in proportion to their cost cannot be considered efficient. What type of war ships should we then aim at producing? For my own part I feel strongly that all our larger vessels should carry heavy guns, be good cruisers, and be *lightly* armoured so as to cope with any vessels they are likely to meet with². Unless our vessels of war are fitted

¹ Page 480, par. 4, vol. 20, of "Journal of the Royal United Service Institution."

² By substituting the curved plating for the 2' plating now on the lower decks of the "Nelson" and "Northampton," as shown at plate 14, page 475, vol. 20, of the "Journal of the Royal United Service Institution," the whole of the battery guns of these vessels could have been of 18 tons weight and protected by armour, with the further advantage gained of an improvement in their watertight compartments. R. A. E. S.

to keep the seas, and to engage anything that they may come across, we really cannot preserve the empire of the ocean and efficiently protect our vast commerce. It is quite true that in the old time fleet vessels or line-of-battle ships did engage with line-of-battle ships, and frigates with frigates; but anyone who looks at the times must see that those days have passed away, for steam has made an entire change in the whole system of warfare. The turbine has been mentioned as a motor. I believe the turbine would be a very important adjunct for moving our vessels, especially those long vessels of the "Minotaur" class, to which the turbine could be easily fitted and used to move their bows and sterns very rapidly. The advantage would be, that while turning they could not be easily rammed, and were they to be so, the vessel ramming would get her own bow twisted by this motion. Mr. Griffiths has shown how to ease the screw, and pointed out how valuable this plan could be made for the discharge of water. His arrangement is in fact a capital turbine. Another point which has been raised is, whether the fish, the Harvey, or any other torpedo is the more efficient. I think they all have different points of excellence which are available under different conditions; but there is another weapon which could be made far more effective than any of them, and that is the rocket. It is as yet undeveloped, but it has these positive advantages over either of the others, that it can be easier handled, has a far higher speed, and the further great advantage that while the others are losing speed, so that striking they would not perforate the bottom of a man of war, the rocket would be gaining speed, and would readily perforate the greater number of war ships. I think therefore it is a weapon that is well worthy of our consideration, more especially as the rocket can be used for firing in the air, as well as through the water.

Admiral RYDER: In offering a few observations on this subject, I propose to run through the various points very shortly, and confine myself to the useful summary the Council have wisely drawn up. (1.) As to "the amount of reliance which may be safely placed on steam propulsion, and on depôts for the supply of coal." Captain Colomb has done great service to the discussion of his paper by his map, which points out the links in that chain which pretty well encircles the world connecting our coal depôts, and it is a question for statesmen perhaps more than naval Officers to what extent this chain should be lengthened. We welcome our arrival at the depôt and take the coal from it, but we have very little influence over the establishing of these coal depôts, although many of us know where they ought to be. It is a question for politicians to decide when and how they can best complete the links of that very important chain. Unless you have those links completed, you cannot well decide what kind of ships you should build now for the immediate future. It is a prominent part of Captain Colomb's argument, and which justifies him in his opinion in advocating a certain class of ship and doing away to a great extent with the sails we have, viz., the assumption that our Government will shortly and promptly complete that chain. It is also an essential feature in his statement that in time of war we shall find it not very difficult to establish relations with neutral Powers who will, he assumes, supply us with coal. I think that is a very doubtful question. It will not be very easy to persuade a neutral, when he is excessively afraid of the other gentlemen round the corner, to be benevolent with you with regard to the supply of coal. I have just returned from the command on the Japan and China station, and with an imminent prospect of war, I felt very doubtful whether I should ever get a pound of coal without taking it forcibly from a neutral. (2.) As to the best means of protecting these depôts there can be very little doubt they must be fortified. Many of them are not fortified at present. I was only the other day at Singapore, and there I do not think there was a single gun in position, although plans were made out by Sir W. Jervois years ago. There is an enormous coal depot at Singapore for the Peninsular and Oriental Company, also a smaller depôt for the Royal Navy, utterly unprotected, so that an enterprising enemy might run in at night and with a torch set them all on fire. Hong Kong is in the same position, utterly unprotected. Our coal is at Koo'loon on the mainland, quite exposed. I read in the newspapers yesterday, that frantic efforts are being made to fortify Hong Kong, but it is rather late to begin to fortify your Colonies and coal depôts when war is supposed to be imminent. (3.) I will not touch upon the "dangers to which our naval empire is exposed" by the Declaration of Paris. It is a very difficult question;

politicians differ upon it, naval Officers differ upon it, and it is not a question I will further remark upon. (4.) Next in order is the old question of "turret *versus* "broadside." There is a modification of the turret which I think might have been alluded to here, viz., the gun mounted on a turntable *en barbette*, and partially adopted, a modification of the turret which I believe will always be found necessary when you come to have very large guns on deck. In such cases revolving an enormous turret safely and certainly, becomes increasingly difficult; a jammed, and therefore disabled turret, would in our largest ironclads reduce the armament by one-half. We have next the newer question (5) of "The relative value of beam and "end-on fire." Captain Colomb attaches much larger importance to the beam than the end-on fire. I ask for both. I am not prepared to give up end-on fire; I would like to have as much of both as I can consistently with all the various requirements of naval armament. But particularly, I think now-a-days we want a powerful STERN end-on fire, for we are exposed to attack from swift vessels that are intended to "ram," coming up astern. When we see such a vessel approaching astern, if we have nothing but a small number (probably of light stern guns), we shall have two dangers to provide against. If we turn towards her, we are in a particularly awkward position for being rammed, and if we keep on, and she is faster than we are, it seems to be inevitable that we shall be rammed unless we can destroy her by fire from the stern guns. Of course if our vessel is a double-ender and has a propeller enabling her to go astern as well as ahead, she will not approach us, but if not, we shall be in a very awkward position if we have not powerful guns to play upon her from the moment she comes within their range. Then (6) as to the question whether *many light or few heavy* guns should form the armament, I think we ought to have both. It is absurd to give us only a few heavy guns and no light guns. We shall often be attacked by small swift vessels, we want in order to meet all comers, a few heavy guns and a great many light guns. (7.) "Whether ships should "be armed to fight only their own or other classes." I think primarily their own, but we should have at least one powerful gun on board each vessel to give little vessels a chance when they are overtaken, as they will often be now, because the small vessels have the least speed (except the new torpedo vessels) and unless the small vessel, corvette, or gun vessel can get a big gun into play she will be run over or captured. In the old days the speed was with the small vessels, the frigates, corvettes, brigs, and they could get away. Now it is with the big vessels, and the small ones are sure to be taken unless they have that chance of disabling their opponent which a heavy gun would give. (8.) "Whether is the gun or the armour nearer its final limit "of strength for a given weight and space," I do not believe we know anything about it. At present we are quite in the dark as to which is ultimately to win.¹

With regard to the relative value of the ram, we have had many disastrous proofs in the last two or three years of the enormous power of the ram. The Admiral of the Fleet, Sir George Sartorius, deserves great credit for having preceded all of us in his persistent advocacy of the ram; the ram is a tremendous

¹ "I know that Mr. Barnaby, the Chief Constructor, looks forward to the complete abandonment in future first-class fighting ships of armour-protection for both "buoyancy and stability."

These are his words, p. 13, 18, 19 of a statement lately printed at the Admiralty, entitled "H.M.S. Inflexible," by N. Barnaby, C.B., Director of Naval Construction.

"With precise experiments, I look forward to the complete abandonment, in future "first-class fighting ships, of armour protection, for both buoyancy and stability. It is "only in this way that the growth of the gun and of the armour can be met; but in "this way it may not only be met but arrested. So long as a single effective blow "by the gun can disable the ship, attempts will be made to produce such guns and "to resist them. With an unarmoured cellular structure for the protection of "buoyancy and stability, and several armoured citadels and communications, no single "blow would disable the ship; and both guns and armour would cease to increase "in size, and the guns would rather be multiplied in number and in shell power.

"Such ships would approach again the conditions of naval warfare before steam "was introduced, when no single blow from the gun, however powerful, could be

weapon, and we know now what prompt mischief it can do, and no doubt in future actions it will be a very prominent means of attack. (10.) "The relative values of the spar, the Harvey, and the Whitehead torpedo." As far as I have been able to study the subject I believe the value of the spar torpedo against a vessel at anchor, unprotected by steam launches, is very great in the hands of plucky men. Its use would have the effect, as it had in the German and French war, of obliging the blockading ships to career up and down off a blockaded port. The French

"expected to be fatal. I repeat that I am prepared for this issue of exhaustive experiments.

"Fighting ships may be divided into two great classes, *unprotected* and *protected* as to guns, buoyancy, stability, and machinery.

"The unprotected ships are of all sizes from the smallest sloop to the vessel of from 5,000 to 6,000 tons displacement.

"In none of these is there any protection against shell-fire except such as may be given to engines and boilers by coal. The ordinary merchant ship, if properly divided into compartments, may be made quite comparable in defensive strength with the regularly-built war ship of the type of the 'Inconstant,' 'Raleigh,' 'Boadicea,' 'Volage,' and smaller ships.

"Of protected ships there are many varieties:—

I. "The ships of the 'Comus' class, *i.e.*, corvettes of 2,300 tons displacement.

"They have an *underwater steel deck wrought over the engines, boilers, and magazines, with a raft body above it.* This is, in virtue of its position as against blows of projectiles, as effective a protection for these parts of the ship as would be given by armour on the sides.

II. "The ships of the 'Warrior' type, *viz.*: 'Warrior,' 'Black Prince,' 'Resis-

"tance,' and 'Defence.' These ships are divided into three parts longitudinally. There is a middle division, varying between one-half and three-fifths of the whole length of the water-line, which has a belt of armour on the sides and ends; and there are two end divisions protected by an underwater deck, as in the 'Comus,' but without a raft body. In this respect they appear to me to agree precisely in principle with the designs got out by Mr. Reed in 1869. The 'Resistance' and 'Defence' have a protected part for half the length of water-line, and the 'Warrior' and 'Black Prince,' which are 380 feet long, have armour for only 213 feet. These ships then have, as above stated, three divisions, *viz.*, *side-armoured middles, and protected ends.*

III. "There is the ship protected by *side armour throughout the water-line*, associated either with a short or with a long and continuous armoured battery overhead. In the latter case the ship is said to be completely protected, in the former only belted; but in neither of these cases is there a protecting under-water deck. This class includes nearly all the completed ironclads of all navies, and all the protected ships designed in England between 1861 and 1873.

IV. "There is the ship protected by *side armour on a middle division of the ship, associated with protected ends and raft bodies.* In this division is included the 'Inflexible,' 'Ajax,' 'Agamemnon,' 'Nelson,' and 'Northampton,' the 'Duilio,' 'Dandolo,' the French 'Admiral Duperré,' and the German ships, five in number, of the 'Sachsen' type.

V. "There is the ship with protecting deck and raft bodies from end to end, without side armour, but with armoured batteries, to which it has been understood that the 'Italia' and 'Lepanto' are to belong, but of which there is no actual representative at present.

"In my opinion all ships of 3,000 tons displacement and upwards, should be protected. Those intended for high speed and cruising, and not having large batteries, or many men about the decks, might be well protected either as Class I. or as Class II. The great favour which Class III has received in all navies, and the large number of existing ships of the type, will perhaps cause it to keep in favour for second-class battle ships for a few years more. Class IV must take all

ships hardly ever remained at anchor for the night before a German port, because they did not care to expose themselves to the attack of fast boats coming out with spar torpedoes. As to the Harvey and the Whitehead, I feel very doubtful myself as to their being of any great benefit *at sea*. I went on board the "Thunderer" the other day and saw 15 magnificent machines in a splendidly illuminated store room. They were of the most delicate character, and evidently required as much care as the chronometers. I doubt whether in action any of them would do what they were told to do. I think it is very probable they would do what they were not told to do, and that it would be very awkward for some of us they should do, viz., explode prematurely, or mistake friend for foe. (11.) "Then as to the entry and training of Officers 'and men.' This is a very large question. Someone spoke just now of the age for entering young Officers. I agree with Admiral Hamilton, that, provided we drew our supply from the best public schools at, say 14, the age for joining, *sea-going* ships might with proper precautions be advanced. It is a very difficult question, but I am of the same opinion as I was some years ago, when the late Captain Goodenough and I read papers here on the education of young Officers. With regard to the training of men I believe we train them well in our training ships, but there seems to be a difficulty in getting them out to their ships on foreign stations after they are trained. I have heard only one opinion on the subject from all the Officers who have commanded the squadron of training ships, Captain Tremlett, Captain Jones, Captain Wilson. I have taken great interest in this important subject for many years and always kept up communications with the Officers I have named who have been in charge; there seems to be an impossibility in connecting the training ships at

"first-class ships for the future, unless Class V should establish itself, and in that case it is likely to become the permanent type, with general improvements in the manner of constructing the raft and mounting and protecting the guns. If we are obliged to stop at Class IV there may be a greater widening and shortening of the ship than there is in the 'Inflexible,' and both the gun and the armour will grow. If we can happily succeed in passing to Class V we may have more reasonable dimensions in ships and the increase in thickness of armour and in power of individual guns may be arrested."

I feel confident that the readers of the Journal will be well pleased to see what are the views of Mr. Barnaby in 1877, and those of them who read at the time the Reports of the Committee on Designs of Ships (1871), or who now turn to them, will readily recognize in type V the design submitted by the dissentient minority, and pressed on the attention of the Admiralty as fit for prompt experiments. The dissentient minority fully urged this design, the Admiralty draughtsman appointed to assist the officers having certified to its stability.

Mr. Barnaby states, pp. 9, 10, that the "great cost of such experiments and the difficulty of making them conclusive within a reasonable time, caused their postponement."

Surely when the cost of ironclads varies from 350,000*l.* to half a million and more, the necessary experiments must indeed be very costly, and the time necessary to conduct conclusive experiments very great, to justify their omission. It must not be forgotten that it is over six years since the Committee on Designs reported. These experiments on raft bodies, &c., were unanimously recommended for prompt trial.

¹ "We don't recruit our boys in the right way, by the right means, or at the right places.

"We require about 3,000 boys a-year to recruit our 18,000 seamen in the Royal Navy; the Merchant Navy would require about 16,000 boys every year if they were solely dependent on home recruiting and did not rely, as they unfortunately are now obliged to do, on the presence of large numbers of foreigners (over 14,000). 3,000 boys for the Royal Navy + 16,000 boys for the Merchant Service = 19,000. There are more parishes in Great Britain and Ireland than 19,000. One boy from each parish every year would recruit both services. It merely requires organization—the National School Inspector should have the giving away, as prizes, of nominations to the Royal Naval Training Ships. How keen would be the excite-

home with the sea-going ships on foreign stations. When the training of the boys is finished, they are sent to the receiving ships at Portsmouth and Plymouth, and there they have frequently been kept waiting for many months while there has been plenty of room in the ships in foreign stations for them. The only difficulty was how to get the boys out to the foreign stations. On some stations ships come home at very short intervals, on others at long intervals. That is so on the China station,—we hardly ever had a man-of-war going home or coming out, they were re-commissioned out there. The result was there was rarely any opportunity for a man-of-war to bring out the boys. I could never understand why they could not be sent out in the Pacific and Oriental ships, it is merely a question of expense—why 30 or 40 boys should not be sent out under charge of a sub-lieutenant to the East Indies, China, and the Pacific I could not understand. Unfortunately, many of the boys when in these receiving ships in England get into mischief and ultimately, when they come out to the foreign stations, instead of being the capital article they were when they left their training ship, they are partially demoralized and certainly come to grief in much larger proportion than would be the case if they were sent out promptly. In spite of this our men are much improved of late years—the troublesome men form a small minority of the crew, but it is much to be lamented that the desertions are so numerous, and the number of re-entries, after the first term of 10 years, is not much larger; the result is that the average age and *physique* of our ships' companies is much below that of foreign Powers.

There is another point, and that is the composition of our ships' companies. In deciding upon the number of boys required annually to fill up the waste which is the essence of the question, and is now about 3,000, we must look at how the ships' companies are composed, and we shall be startled at the very marked difference between English ships' companies and the ships' companies of other nations. We in the English Navy, as different wants have been created on board, we require more domestics, lamp trimmers, storekeepers, &c., and introduce *landsmen* for the occupation. The French insist upon almost everybody on board being a combatant: he must be a sailor or have been a sailor; he must learn his drills steadily; he must be able to defend himself if he is attacked. We are sliding down the other scale. In the "Audacious" 25 per cent. of the ship's company were non-combatants, they did not know one end of a rifle from the other, and I was forbidden to expend powder in instructing them; these men could not have defended themselves respectably from any French sailor lad. In the "Thunderer" class the proportion of combatants is much less. In the French line-of-battle ship alongside of the "Audacious" at Hong Kong, *only five per cent.* of her ship's company were non-combatant. How would this affect the result of an action? If those ships had been engaged in combat I know as a fact that she had 100 more combatants than I had, although I had a larger ship and heavier guns. This again is, I believe, a mere question of pounds, shillings, and pence. (12.) As to our "Reserves," I had the honour of commanding our Reserves for three years, and I believe the system is a thoroughly good one. I re-echo entirely what Captain Verney said, I believe the Royal Naval Reserve are a splendid

"ment in each parish—how proud the parents would be of their sailor boys when
 "they returned after 6 months! Whatever difficulty there might be in persuading
 "shipowners to take the right number of lads in their ships to feed the waste among
 "merchant seamen, there need be no difficulty as to at once recruiting for the Royal
 "Navy its 3,000 boys annually from the rustic parishes. The boys we want are
 "boys with respectable homes and with both parents living—they need not be the
 "best at their books, but they should be the best cricketers, climbers, &c. In fact
 "the Royal Navy should and would have the pick of all the boys of the three
 "Islands, long before the recruiting sergeant had a chance, owing to the different
 "ages of entry. Each of the coast guard ships would have her rural district
 "stretching far to the rear from which she would receive boys. Every boy, every
 "parent, every schoolmaster in the British Islands would know in which training
 "district he lived, and where the Royal Naval Training ship of his district was
 "placed, and what were the qualifications which would earn a nomination."—
 A. P. R.

body of men. I used to induce naval Officers and members of Parliament sometimes to visit with me the "President," the Reserve Training Ship in the docks, to see the Royal Naval Reserve men at their drill. I never took anybody down but what he was pleased at the appearance of the men: in fact they are the cream of the merchant service; but whether they are good or bad they are the best that are available, and within a very small number, *all* that are available and qualified, and we have none too many of them. I believe we have some 14,000 now, in the first-class Reserve, and a few thousands in the second, also an invaluable body. The Coast Volunteers I believe have almost disappeared, we have also the Coast Guard, consisting of about 4,000 men. Our Reserves, barring that they are much too few in number, are in a wholesome condition, but just compare them with the French Reserves. The French system passes 7,000 fishermen and merchant seamen through the Royal Navy every year, keeping them under drill from 3 to 5 years. The result was this, that, in the war with Germany, they had 70,000 seamen under arms, independent of the marines, and were able to send a splendid *corps d'armée* to Paris that did excellently good service there. I should like to know how many seamen we could afford to send to defend London. We have not got half as many on active service and in the Reserves as we ought to have in order to be prepared for a hot war with two or three European Powers and the United States. They are very good as far as they go, but they are not half numerous enough. (13.) The Naval Volunteer Corps is a useful experiment, with the idea of popularising the Reserves with persons on shore, and I believe they would do right good service in harbour-defence if called out. If we have in the Royal Naval Reserve *all or nearly all* the qualified A.B.s in the Merchant Service, and if, as I mention, the number of seamen and marines on active service, plus the Reserves, are not nearly sufficient to meet the requirements of a hot naval war, it is evident that two steps should be taken, viz.: first, to gradually increase the former, viz., the numbers on active service, commission more ships as required, and then take steps for replacing the foreigners by native seamen by multiplying training ships and inducing shipowners of sailing ships to carry more apprentices.

I should like to say a word or two upon the points your Lordship added to our list as to (14) "Canvas or steam," it is a very large question. I do not see my way until those coal depôts are created, or until I know that the Government have set to work to obtain them, to giving up sail for the second-class ironclads, which would be the flag ships, and the more important ships on the district stations, or to reducing the canvas. But I make Captain Colomb a present of the "Audacious," and all the existing ironclads. She is by no means a ship that illustrates what a second-class ironclad should be. I believe it is within the powers, intelligence, and zeal, never equalled, of the members of our constructive department to design a second-class ironclad fit to be a flag ship on our foreign stations in peace and one of many in war; if they were told that the ship must have sufficient canvas to beat to windward, say a mile an hour in moderate weather, which was as much as the old line-of-battle ships could do—if this were done I have no doubt they would succeed, and in the course of a few weeks give us a good working design, aided by Mr. Froude, who says great beam has no effect in diminishing speed. Mr. Reed undertook to inform the Committee on Designs that he saw not the slightest difficulty in doing this, that he was perfectly confident it was within the power of any naval constructor of intelligence to design an efficient second-class ironclad that should be as good a sailing ship as any wooden frigate we had ever had, and I want to hear from the constructive department "whether they can or cannot accept his challenge;" the moment Mr. Barnaby says it cannot be done, I shall bow my head and say "then I admit it cannot be done." He has not said that yet and I do not believe he will.

With regard to "classification," I have little to say. As your lordship correctly stated the four gentlemen who sent in papers had different classifications, but I am confident if they had the opportunity of putting their heads together, they would, in the course of one day, agree upon *one* classification. I do not believe there is any radical difference between them, or that they would not arrive at a unanimous conclusion if they conferred together on the point. With regard to "duality of propellers, engines, &c.," it is a necessity, but there is a risk in one kind of duality which I believe has presented itself to the minds of our constructors. It is said, our later ships have a longitudinal and almost complete bulkhead fore and aft, with hardly any

opening in it, in order to confine the water on one side only, and thus limit the quantity of water that finds entry into the ship. There is the risk! In many of the monitor class, the ships are remarkably tender, and they reach their angle of maximum stability very early, and if you put a complete or almost complete iron longitudinal bulkhead with no or insufficient communications between the two sides, you may find after the vessels are rammed that they will fill on one side and roll over like turtles. I think Captain Dawson made some remarks upon the seagoing qualities of the "Hecate" and "Gorgon" class. There have been so many Committees, and so much inquiry into the qualification of the various classes of ships, that I dare say that the reports of some of these Committees may have escaped the recollection of gentlemen who perhaps at the time were interested in them. I should like to place on record the opinion of the Committee of Designs (of which my Lord Dufferin was the chairman, and six naval Officers and numerous civilians were members) of that class. As regards the "Gorgon" class, which Captain Dawson so severely criticized, I think the Committee (of which I was a member) went almost further than he did in their virtual condemnation of this class as seagoers. Their unanimous report was this, that "if a certain superstructure extending along a good portion of each side was not put on, they would be safe to go from port to port only in fine weather." That is a very startling statement to make about ships of war. Now that superstructure has not been put on! I do not know why it has not been put on. It is five years since it was suggested by us that it should be put on, and we carefully considered the phrase given above. I remember there was a considerable discussion about the word "*only*," but at last it was put in; and those ships are stamped with this character—that they are in their present condition *safe to go from port to port only in fine weather*. I believe they are now assembled at Portland, and it is stated in the public press, with the prospect of a cruise to *Berchaven!* With regard to the "Turbine," I believe that it is a much neglected propeller, for reasons which would be too long to enter upon here. The poor turbine always had the cold shoulder turned to it. The inventor of the turbine brought it forward; it was put into a man-of-war, the "Waterwitch." The "Waterwitch" was tried and the results were most remarkable. She was tried against two other ships, her sisters, with two screws, and this was the result, as I read at the time, that one went 9.3, the other 9.2, and the third 9.1, and the "Turbine," the novel invention, with all the disadvantage of novelty, gained the intermediate speed of the three. The ships were fairly equal if not identical in all other respects. The "Waterwitch" was put into the steam-reserve, and she has been used once or twice as a gunboat. No other ship has been built to illustrate the principle, but the turbine, I believe, is the propeller of the future, if only it can struggle out of the difficulties which have surrounded it. Surely the fact that the "Waterwitch" when first tried realized a speed of 9.2, and that the turbine alone can be relied on for reversing promptly the line of motion of a ship without turning, cannot be fouled, and has in its engines an enormous pump efficacious in case of leaks and fire, justifies a further trial in a more suitable vessel, with engines better adapted to the purpose.

Commander GERARD NOEL: My Lord, I address you on this occasion, though perhaps it would have been better if I had deferred doing so until later, but I am afraid I shall not be able to attend an adjourned discussion. This is the first time I have had the honour of addressing the members of this Institution. They, however, did me the honour of meeting to discuss an essay of mine two years ago, which I am afraid was pretty well pulled to pieces on that occasion, and I am very sorry I was not here to defend it myself. Now we have to discuss Captain Colomb. Captain Colomb is an old adversary of mine, not that we have entered before into the same contest, but he has criticised my writings, and I have quoted his. To begin with, I very much agree with Captain Colomb on several points which have not been referred to on this occasion. One is the question of watertight compartment; I am a very strong advocate for doing away with all watertight doors; I think they are the most dangerous things that ever were invented. Build your bulkheads up to at least six feet above the waterline, and then your ship will be safe. The German ironclad that was sunk the other day, might have been afloat now if her watertight compartments had been effective.

As regards gun power, I would ask those interested in it to study the first three

tables in my essay. They tend to prove—and I think the data is pretty good—that if you have 1,000 tons of armament to carry in a seagoing vessel, the 9-inch gun is the one you can carry with most effect. There are here shown nine systems of armament, each weighing 1,000 tons; which of these do you intend to put on board a man-of-war? Speaking of them in the essay, I say, "Studying the results produced in this last table we observed that system 6 (viz., thirty 9-inch 12-ton guns), can not only throw five times as much weight of metal as system 1 (80-ton guns), and $2\frac{1}{2}$ times as much as system 3 (35-ton guns), in a given time, but also more than trebles the total remaining energy displayed in the same period by system 1, and doubles that displayed by system 3, even at so great a distance as 4,000 yards." If you wish to put 1,000 tons of armament into your vessel you could put thirty 9-inch guns, and that would give a result of throwing five times as much weight as system 1; that is four 80-ton guns which would constitute the same weight of armament, and $2\frac{1}{2}$ times as much as system 3, that is twelve 35-ton guns.

I always have been very much opposed, in my humble way, to a small number of large guns—putting all your eggs into one basket. If your gun is disabled, where are you? If you have a large number of guns, half of them may be disabled, and you have still the other half to fight. You have an extended battery, and though Commander Custance just now told us an extended battery had its faults, and no doubt those faults are of great importance, still you will have with it a reserve of fire; a material reserve of force when part of your battery is disabled.

Another thing is the manner in which I propose the armour should be placed. I would have the battery armour throughout two-thirds the length of the ship, not only so that your battery should be distributed through a great length, and your gun-fire should be effective, but also with regard to the *watertight compartments*. This battery would close in the whole ship, and as what I propose is, only to have the battery-armour as high as the gun-port sills (no armour above that, everything above as light as possible, steel, anything you like, but as light as possible, and of such material as would not make splinters), the watertight compartments would, I say, open into this battery, and you would have no entrance into the bow or stern of the vessel outside the battery part as I call it.

There has been much talk about the "Inflexible." Now I am very much opposed to her. Her great weakness is, I think, that water may get into the bow compartments after she is wounded. That I consider a very important thing, for when a vessel is water-logged and sunk by the bow she is powerless and at the mercy of her enemy; I would therefore, in the ship I propose, fill in with cork to a considerable height above the water-line, and so let the shots come in as thick as they like through the unarmoured part, and yet no water would get into the ship; a thing to be avoided, especially in the bow. Then another weakness is that the armour-belt in those vessels of the "Inflexible" type does not strengthen the stem for ramming.

Captain Dawson has been kind enough to throw a heavy shot against my coast defence vessel. A 10,000-ton vessel for coast defence I spoke of as a floating fort, and I consider it is very necessary that on our coasts (home and colonial) we should have such forts. Their displacement may be 20 or 23 feet, but the tonnage might be anything—10,000 tons is not too much. You require a vessel that will *hold the sea*. Gunboats will not hold the sea; a gale of wind comes on in the Channel and all our wretched little gunboats have to tumble into harbour head over heels; the gale abates, the enemy comes upon us, and where are we? Our gunboats cannot stem out in time to defend our shores. Now a wholesome vessel of 6,000 or 10,000 tons, with plenty of beam, would hold the sea. I propose that these vessels should be armed with *really* heavy armaments; let their beam be considerable and the armament of the larger vessels be at least twelve 38-ton guns. I believe it is possible: I would place these guns in small turrets which should simply be a cover for the breach of the gun; the turntable would not be more than 15 feet in diameter. You place your gun on the carriage on the turntable and place an armoured cover over the breach. You have twelve of these guns round on a breastwork deck, similar to that of the "Dreadnought," only perhaps with a little more beam.¹

¹ I intended describing coast defence vessels, as including in my opinion all mastless ships of present construction, and of giving them the further denomination of

Now for the question of steam *versus* canvas. I find the other three essayists would give up masts or next door to it. I advocate canvas, I think that canvas *is* necessary; I do not see that science has arrived at that point when it can ignore the elements. I think that if science is really science it will make use of those elements, and the greatest element we have to deal with as seamen is the wind. The wind will blow till the world comes to an end. I see no reason why we should not reduce the top hamper, and for that purpose you might introduce steel wire, steel masts, and introduce steel into your yards; have your yards to brace fore and aft. Let science do that for us, but do not let it take away our masts; it is not time yet. As regards the non-combatants on board I have endeavoured to point out the difficulty of training what I call seamen proper. There is no doubt about it, the difficulty is such that we must keep our numbers under. We cannot train any very large number of seamen. We do not want a very large number of seamen; if we can have 12,000, or I think we have now 12,000 able seamen and petty officers—if we can keep that number up it is all that we want. We must fill our crews up with other people, and we can find use for these men on board every ship, not actually perhaps all of them as landing parties, but still they will be useful for transport, for assisting the ambulances, &c.; but we must keep our numbers of actual seamen in hand. In the last 3 tables I have endeavoured to show you how I propose the men should be distributed. I there make use of our Reserves in case of war, and altogether we can add up over 80,000 men with the Marines and Reserves; the stokers we should get from the merchant service; the domestics and those sort of people I have put down and think will be forthcoming in numbers as many as required.²

Captain Long spoke about a double screw vessel turning out of the way in the case of ramming. I think he will find a single screw when at full speed will turn with the helm as fast as a double screw.

Captain CROZIER: In the experimental trip between the "Waterwitch" and the "Viper," the twin screw succeeded in making on the measured mile 10·5 knots, while the "Waterwitch" scarcely realized 9 knots. The "Viper" went to Liverpool and was then ordered, "after some time," to the coast of Ireland, steaming some 2,000 knots. She subsequently returned to England, and made a voyage to Bernada, about 4,000 knots, under her own sail and steam, where she remained. The "Waterwitch" in smooth water and under the most favourable circumstances was able to make about 9 knots, but having had part of her weights removed and trim altered, she succeeded in making 9·2 knots. On one occasion she got into the trough of the sea, off Portland Bill, and her propelling power ceased, the seas washing over her, but *fortunately* they were able to get sail on to the vessel, and in that way she succeeded in getting back to Portland. When the weather was fine she was sent to Plymouth, paid off, and has never been commissioned since. Those facts I think will prove that unless some very great alteration takes place in the turbine, in a heavy sea or with a strong breeze it is absolutely useless.

On the motion of Captain J. C. Colomb, R.M.A., the discussion was then adjourned until the 26th instant.

coast "attack" vessels, for, when our coasts or those of our colonies are free from the danger of attack, from the enemy's forces, such vessels would be at liberty to assume the offensive.

² I intended to say in answer to Admiral Ryder, that I would presume to remind him that the system of obtaining men, *ad libitum*, and for short periods of service by "Conscript" gives the French the advantage of us in obtaining and training seamen. It is principally due to this cause, that we find a greater proportion of combatants in the crews of French men-of-war than in our own—G. N.

Wednesday, June 26th, 1878.

ADJOURNED DISCUSSION.

LORD HAMPTON in the Chair.

Captain J. C. R. COLOMB, R.M.A.: My Lord, I feel almost oppressed by the vastness of the ground one has to cover in the very little time necessarily allotted to each speaker to convey his views. I approach this subject from a different point of view to that adopted by the majority of the speakers. The subject for the Prize Essay was "The Development of the Imperial Maritime Force," and that particular word, "Imperial," calls up the particular part of the subject with which I wish to deal; but this Institution is not the proper place in which to do so. If our naval power means anything, it means the protection of our commerce as a fundamental part of the duty of the Navy. When one remembers the rate of development of commerce in other parts of the Empire, and also that at present our naval power is only furnished by one part, that is enough to indicate my difficulty in dealing with this question in the way I could wish. I will just mention one fact to show what I mean. In 1805, the year of the Battle of Trafalgar, when our naval power primarily existed for the defence of our commerce, the sea commerce belonging to the United Kingdom amounted to about 60,000,000*l.* a year. The sea commerce of the United Kingdom, taking the returns for last year, is 655,000,000*l.* a year, and the sea commerce of our colonies is 300,000,000*l.* a year. Now, the broad principle on which I would have wished to have approached this subject is, that if our naval power is for the protection of our commerce, it should have some relation and direct proportion to the different parts of the Empire which furnish that commerce. In 1808 a very remarkable book was written by Sir Charles Pasley, a celebrated engineer; and he points to this fundamental maxim, and hands it down to be practically interpreted by posterity, "that the strength of the British Empire, separated by long sea distances, is greater or less in proportion to the capability and ability of the several portions of the Empire affording each other mutual succour and support." Seventy years afterwards we have the Indian troops at Malta, and it is supposed to be a new discovery of our military power. But the naval aspect of the question appears to me not to command the attention it deserves. Those troops are at Malta, and they have moved in time of peace; but when the stress of war comes, and you have to carry out your principle of the different parts of the Empire affording each other mutual succour and support, you cannot do it unless your roads of communication are clear; and it is for the safety of the communication of the ocean and the seas that we must develop our maritime power, and therefore, in the first place, I wish to say that I would rather refer very briefly at first to the defence of our sea roads. The military concentrations of the present day depend upon something more than protection, they depend upon the power of locomotion, and we rely in moving those forces by sea entirely upon steam; therefore the military strength of the Empire at this minute really, putting aside for the moment the naval protection, rests and depends and relies upon steam power. Now come to the next question, the position of the Empire from another point of view. The Empire may really be regarded at this moment as a vast commercial speculation, with its head-quarters in the north-east Atlantic, having laid its money out in various quarters of the globe, and upon the freedom of communication depends the commercial strength of the country which furnishes the means of developing your maritime power. Your greatest commercial transactions are based upon the precision and certainty of your steam communications; therefore my second point is that the commercial prosperity and strength of this country frankly places its reliance upon steam.

That being the case, there is a third aspect of the question, and that is that upon these water roads depends the sustenance of the people at home. I will only give one or two statistics to enforce this: I am dealing with the sea roads, and I wish to enforce that point most strongly. In the seven years ending with 1840, the imports of wheat from foreign sources into this country amounted to 6,000,000 quarters. For the seven years ending with 1877 what do you think the grain imports to this country were? 370,000,000 quarters. Now that is made doubly important by remembering that in England now, as compared with the England of twenty years ago, there are 800,000 acres less wheat grown; and, to sum up shortly, in 1846 the import of corn and flour amounted to 17 lbs. per head of the population; but in 1876, thirty years after, it amounted to 167 lbs. per head of the population.

Our military strength relies upon steam, our commercial prosperity and success depends upon steam,—they have both frankly accepted it,—and the protection of these great sources of our strength rests upon the Navy; and the first general principle I would ask you seriously to consider is, that put forward so prominently in the Prize Essay, and I would ask, is not the protecting power going to put the same reliance on the same agency, as the things and forces it has to protect? That is briefly my argument in favour of our Navy placing a frank reliance upon steam, putting aside all technical considerations.

Now I say that the answer to the question, whether you are going to frankly rely upon steam or not, affects in general principle almost every naval detail. It affects it in many ways; and it is no answer to the advocates of reliance on steam for others who are antagonistic to the view to say that your coal might fail. I say if you are to place, as I maintain from my point of view you must place, reliance upon steam, then the first principle of your naval policy is to take care that your coal shall not fail. If the Empire is anything it is an Empire of coal. The British dominions contain the great wealth of coal which is necessary, and it appears almost to have been destined by Providence to enable them to carry on the operations over these sea communications. I would first allude to one remarkable fact; a colony—a fragment of your Empire—exports at this moment more coal than the whole of the United States of America. I mean the Colony of New South Wales. Therefore, I say, from the natural and geological structure of the Empire you have no reason for being weak-kneed as to your supply of coal. What you have in effect really to look to is to ensure that your naval policy and arrangements shall ensure that you will be enabled to make use of what nature has so liberally provided you with. The argument that your coal may fail may be applied to war operations in a rather startling way. You might as well, to my mind, logically say, "Take care how you trust to firearms, because your ammunition might fail." I think the great object of these discussions is to elicit "general principles;" and approaching the question from the military concentration point of view, and the commercial success point of view, I say the Navy must place a frank reliance upon coal.

The next general principle I wish to bring forward is this: you have got to defend your sea road. I do not care whether roads are on land or on sea; there is one rule I defy people to argue down, and that is this, that the primary defence of the roads, sea or land, depends upon the safety of the points which command them, and that to cripple your enemy's roads, the first thing you have to do, is to seize or mask the commanding points. I will not enter into the question of what are the points; they are well known to every member of this Institution; but if that is a general principle of naval policy, let me ask, has it been acted upon? Certainly not. With the exception of the Mediterranean line, and perhaps Bermuda, you cannot point to a place commanding our roads that we have in any sense protected. If you ask nine people out of ten about the command of the sea, they say, "We have a fleet of iron-clads; it is all right; they will protect it." But I maintain the Fleet cannot protect the sea roads except the points are otherwise secured as well against all applications of a hostile force. That being the case, it becomes a question of naval policy, are those points to be protected by naval or military force? That would open too large a question; but I will limit it to this: are these places to be protected by ships? I say most assuredly not, and for this reason, that the real power of a ship lies in its power of locomotion, and the area over which you can apply it, and if you take that power away from a ship by permanently limiting its action to a particular

point, you are taking so much naval power away from yourself. The object of defending your fixed points is to release your Fleet, and therefore the principle I maintain is this, that it should be a fundamental part of your naval policy, and the development of your maritime power, to adequately defend, by other means than ships, these fixed points. I would, with all respect, say this principle has not been forced upon the attention of this country by naval Officers as I could have wished to have seen it, for I think we should all proclaim, with no uncertain sound, that if the country expects the Fleet to "go anywhere and do anything," it must by other means protect the points that command the Imperial communications. By following general principles I think you come nearer conclusions as to details. You have got this far in your general principles—you must view your naval power pure and simple as the power to keep up the communications between those fixed points, and to prevent their being interfered with by a hostile force. That is a matter of sea strategy; and the first principle of sea strategy is, I maintain, the maintenance of the fixed points by other forces than your Fleet. Very well; now, the main object to be obtained by this movable force that is so released from fixed points, is that it shall have to the greatest possible extent the power of concentration and the power of dispersion. Now, that is the strategical question, and must in a primary way influence your naval policy of construction; and in order to bring a detail such as the "Inflexible" to the true test, you must bring it to the test of the general principle, and ask, does this in itself represent the greatest power of concentration and dispersion with regard to the area over which it has to act? And I go so far as this—that as the object of strategy is "to ensure the right force being at the right time at the right place," the object of tactics is to accomplish the work which strategy requires to be done at these places, and that the tactical development of your Fleet is inferior in consideration to the strategical requirements of your Fleet. Therefore, to sum up shortly, with regard to fighting ships, I submit to the meeting whether we might not have got more daylight into this confused subject if it had been approached in a different point of view some ten years ago. If strategical power in a fighting ship must involve tactical weakness, I would as a matter of sound policy increase the number of ships rather than attempt to gain tactical results satisfactorily in one ship by a sacrifice of strategical qualities. I say with all due respect that when I hear applause brought down by statements that a British ship must be able to fight any other ship anywhere, I confess it always conveys to my mind that great confusion popularly exists between the strategical duties of ships and the tactical requirements which they are to fulfil. In the Army, and even in civil life, as regards land-warfare, strategy and tactics are so understood that you never hear anybody say that cavalry should be able to take an intrenched position.

There is one point mentioned by Lieutenant Haye that I should briefly wish to touch upon, and that is an Intelligence Department for the Navy; and I think the Intelligence Department as sketched out by him somewhat amplified would be of very considerable assistance to naval Officers in grasping what the strategy of the sea in days of steam, means. Sixteen million tons of coal goes out of this United Kingdom annually. Can any naval Officer tell me offhand where that coal goes to? Can you tell me where a fleet, possibly escaping one of our blockades, would be most likely to find coal at any given point and given time of the year on the ocean? Foreigners are not blind to these facts, but there is no Admiralty information to be got. The Admiralty Officers have not time for it, they are not aided by any department whose business it is to collect that information; but I say, on the declaration of war, every commander in all parts of the world should not only know the coal resources actually within his district that produce coal, but he should also know the ordinary channels through which the coal of the Empire is flowing; because it is of the first importance that if you are going to rely upon coal, you should guard not only its source, but the sea lines over which it passes.

I will not enter into the question of reserves beyond saying this,—that I observe, generally speaking, in the House of Commons and out of the House of Commons, in the public press and in this Institution, a misapprehension of the term "Naval Reserves." Now my remark does not apply to the real "Naval Reserve," because that is a force dormant. We pay it, and instruct it, and keep it dormant in peace, but call it out in war. But your other reserve, on which most of your essayists

touch, is the Marine Reserve, and they talk of a 14,000 men reserve for the Navy. Now it is no such thing. No reserve is a reserve which forms an integral part of your active force in peace. Your Naval Volunteers are not a reserve for another reason, because no reserve is really a reserve unless it is geographically unlimited in its application. It must, if it is a reserve for the Navy, and the Navy is liable to serve all over the world, be a reserve which is not hampered by any limitations as regards area. With regard to the Marine Reserve, you have not 14,000 men, because 7,000 are actually an integral part of your peace fleet; you have only 7,000, and you will find that those 7,000 men are not all educated—that only a small portion of them are. You call the Marine Artillery a naval reserve of 3,000 men; why, you have 1,300 of those men serving in the Fleet, and they must be struck out of the reserve. Then you come to head-quarters. You take your staff, your sick, and your untrained, and what do you find? Why, that the Royal Marine Artillery Reserve for your Navy is at this present moment only about 450 men. When you look at the whole list of the Marine Reserve as a reserve for the Navy, I hope that will always be borne in mind. Your marine infantry and artillery, taking non-effectives and effectives, which gives so small a reserve result at the present moment, is a reserve which actually costs one-eleventh of *your whole naval power* as nearly as possible; it cost about about 960,000*l.* last year. If you take the reserves and test them by what the essayist has pointed to as the relation between cost and power, I think it will lead you to some very curious conclusions. Your men are reserves in the Marine forces, but your Officers in the Marine force are not, they are not naval Officers, and they are not capable of performing duties on board a ship of a purely naval nature. How does this arrangement actually affect you? At this moment you are spending 16,000*l.* in half-pay to naval Officers (Commanders), because you have no room for them on board ships, and you are paying 16,000*l.* to Officers of Marines and Marine Artillery on board your ships, and you cannot employ them when they are there. I do think that discussions of a nature covering such a vast ground can only be satisfactorily approached from the sure, certain, ground of general principles. The last gun, be it remembered, at Trafalgar closed a series of practical proofs, and the first gun fired in naval war will open a series of practical experiments, and the result of those experiments will depend upon the correctness of scientific forecast. You may measure in peace the value of scientific forecast when, and not till when, you have *fixed* your general principles. No matter how gallant, how able our naval Officers may be, the supremacy of our Empire in the next war will stand or fall by the true or false application of general principles. Success will depend upon how far the British public and the naval Officers adequately and really comprehend the *principles* upon which we must rely in the next naval war.

Captain CYPRIAN A. G. BRIDGE, R.N.: I ought to apologise to the audience for rising so soon after Captain J. C. Colomb, an Officer who for many years has given so much attention to this subject, and whose name has been so long associated with the most careful consideration of the very important matters which are dealt with in the various essays which have been sent in for the gold medal. I do not hope nor intend to deal with general principles in the same exhaustive and eloquent manner that he has done, but I propose to confine myself to a few remarks upon the Essays and chiefly upon the Prize Essay. The real question asked of the Officers who sent in their Essays was, "How to secure a powerful and economical Imperial Naval Force." Therein lies the great question in which all the others are contained. Strange as it may seem, I am of opinion that that question has been practically very satisfactorily answered in this country—at all events of late years. I do not mean to say that there is no room for improvement, nor do I mean, for one moment, to cast any doubt upon the truth of the remarks which Captain Colomb has given utterance to; but, as I said before, I think in practice this question has been fairly well answered already. I have no intention of dwelling upon the subject, but I will content myself with saying (what any one can verify for himself), that the country is in possession of a force certainly equal, and probably greatly superior to any which any conceivable combination could array against her; and that at a cost not exceeding one-half of that to which the members of such combination are collectively put. Our naval budget is less than half that of the naval budgets of the Powers of con-

tinental Europe put together, and our fleet is very nearly as strong, if not stronger, than all the fleets which continental Europe could equip. I do not bring forward figures because there is nothing easier than, by consulting books like the "Almanac de Gotha," "Whittaker's Almanack," and others, to see at once how true this is. You will find the number of ships, the number of guns, and even the number of men is not much inferior to the number of each which the continental naval States keep in their pay. In addition to that, there is the enormous reserve of power of our vast coalfields, and of the immense manufacturing establishments belonging to private industry which the country contains. I think this fact should be occasionally called to mind in this country where criticism of the naval administration almost invariably takes a turn unfavourable to it. Still, there is no reason for not being fully impressed with the importance of the subject, nor is there any reason for saying improvements cannot be made. I had scarcely read more than a page or two of the Prize Essay, before I was struck with the excellent account of England's position and of the change in that position since our last naval war, which has been given by the essayist. It seems to me there is one paragraph deserving of the fullest consideration—a consideration which unfortunately it rarely has obtained in this country: he says, "a blockade at a distance," by which, I think, he means the cutting of our lines of supply, "is more to be feared than actual invasion." There can be no question in the mind of any one who considers this subject fully, that actual invasion, which we are so frequently guarding against, is far less to be feared than the cutting of some of those great lines of supply for the protection of which we have hitherto done so little. But, I think, Captain Colomb in his Essay takes rather an inadequate view of the duties of the Navy as a defensive force; he is inclined to regard it as a purely *defensive* force—so I understand it. I do not think he has given in the paper sufficient weight to the rule that a *defensive* defence, to be an effective one, should be an *offensive* one. So that the view of a navy's duties in war, which he takes in his Essay, seems to me to be somewhat too narrow. I think we may very safely lay it down, as a rule, that the Navy should be able to attack as well as to defend, and to attack with a view to the destruction of an enemy's forces. Unless we do that, I do not see how any naval war is ever to come to an end. The wars of the present century have proved one thing, if nothing else, and that is that such a thing as the financial exhaustion of a country does not necessarily make a war terminate in a very short time. That was proved, I think, by the example of the American contest, and has been corroborated by the contest which has recently closed in South-Eastern Europe. So that, if we are simply to lock up the squadrons belonging to an enemy in their ports and sweep his commerce from the sea, letting our own trade go on as if there was no war, the probability is that the conflict, the uncertainty, and all the indirect, if not the direct miseries of war will continue, if not for ever, at all events for a great number of years. The proper duty of a naval force, especially of a powerful naval force, and one which is able to hold possession of the sea, is to pin the enemy down to certain places, to establish a military blockade of his fortified ports, and then, when there, to do its utmost to destroy the fleets which have found shelter within. In the late Crimean War our enemies were kind enough to do that for us themselves; but I very much doubt that we shall ever find that they will do so again. That what was done at Sebastopol by the owners of the splendid fleet which sailed from it will ever be done by any nation again, is far more than we can hope for, and therefore we must rely upon such power as we have to destroy the enemy's fleet ourselves, and so place it at the conclusion of the war in the position in which our antagonists in that contest were good enough to place themselves. I also still think that home defence, coast defence, harbour defence, are no unimportant part of the duty of a Navy, even so great and powerful as our own. A naval war is very likely to last at all events more than a few weeks. If we adopt the system of sending our heavy fleets abroad to pin the forces of the enemy in his naval ports, we, to a great extent, leave our own coasts denuded of a mobile defensive force. Now, I see no reason why some unkindly, some non-benevolent, neutral may not intervene in such a contest, may not see that now is his opportunity to do us incalculable damage, he may intervene with a rapidity which steam power places him in possession of, and he may be in so short a time upon us that we may not have sufficient opportunity to prepare for his reception. A harbour,

coast, home defence by naval means seems to me to place this country on a level, and, taken in combination with her sea-going fleet, upon more than a level with the great military Powers of continental Europe.

With respect to the policy which the essayist suggests should be made use of towards the smaller Powers, such as the minor Republics of America, I am inclined to think it is a mistaken one to rely almost exclusively upon a coercive policy. In the first place, supposing the whole of the States of North and South America were neutrals, if we attempted to apply coercion to the Republic of Chili, Peru, or Central America, I am disposed to think we should hear something about the Monroe doctrine from the United States, and I am also inclined to believe the Empire of Brazil would join in and follow the lead given at Washington. The policy to be adopted in such cases, I think, is to provide beforehand by certain international rules or points of international law, whichever we may please to call them, for these contingencies, and to make it the interest of the smaller States not to injure that Power which, being the greatest commercial Power in the world, is of more use to them than any other. It may seem an odd thing, but the two great questions, one of which has been settled comparatively lately,—the “Alabama” question, and another question which was settled some twenty-eight years since, against which we only began to exclaim two or three years ago, that is to say, upwards of twenty years after it had been settled, the Declaration of Paris; the settlement of those two questions, I think, has placed our mercantile marine, as far as regards any attacks being made on it from neutral ports, in a far better position than it ever has been before. Consequently I am of opinion the coercive policy, which I take it is suggested—

Captain COLOMB: No.

Captain BRIDGE: I am glad to hear that correction, because it seemed to me such a policy, and it is a policy which, if not advocated in this Essay, is advocated by many other people, would not only be an unfortunate one, but it would not be necessary. If the Prize Essay had no other merit than this, this alone, in my opinion, would entitle it to the highest praise, and that is that a law is therein laid down which establishes a relation between the strategical requirements of the Navy and the strategical capacity of the individual ships. Having first examined what it is that would be required of our ships in different parts of the world, the essayist has then laid down this law: “We thus see that the propulsive power of a war ship” must be regulated by the geographical conditions of her service;” and we find the propulsive power of our war ships may be governed by a uniform law. If the Essay had contained nothing else, it would for that reason alone be worthy of the highest praise, and deserving of the fullest consideration at the hands of naval Officers. Until some such law as that is considered established and binding upon the people who are responsible for providing the country with ships, we should be going on for ever in a blindfold and groping way, gradually adding a little coal-carrying power to this ship, and taking it away from that, and should be apparently never approaching nearer the settlement of the great question, how best to fulfil the strategical requirements of the British Fleet. I should not have time to go into the various details concerning ships which have been dealt with in the Essays; but it is satisfactory to see that there are several points upon which all the essayists are agreed, that one I mentioned just now, as to the coal-carrying capacity of the ships, they appear to be agreed upon; they also appear to agree that ships of the enormous and unwieldy size, such as have hitherto been built, should not be repeated, and in that they are at one with some of the most distinguished naval architects of the Continent. They also appear to agree with Captain Colomb where he says, it is an error to suppose that guns of 80 tons and upwards are the guns of the future. I do not think any one of them proposes a gun of anything like that weight; 38 tons as an exceptional weapon, and guns of 18 to 20 tons, seem to be those which find most favour with them all.

One observation concerning the sixth paragraph of the last chapter: “Coast and “harbour defence should occupy in the British Empire an entirely subordinate “position.” With that I agree, the position should be subordinate, but not altogether left out; “and the best defence of naval stations is the defence of the routes “communicating with them.” Now I am inclined to think, and I rather interpret the remarks made by the last speaker as confirming me in my opinion, that the con-

verse of that is the case; that the best defence of the great lines of commerce is the defence of various points on them, and we should be rather beginning at the wrong end if we were to attempt to defend the lines instead of attempting to defend the points to and from which these lines led. It is almost impossible to carry out a complete supervision of any greatly extended line, and the only way of doing so effectively, either on shore or afloat, is by selecting certain important points and defending them. I believe a great deal has been done in this way of late, and that the attention of the country has been turned more to the defence of these points than has hitherto been the case; and we should find, I think, if we were suddenly engaged in any naval war, that more systematic arrangements have been made to defend many of the important positions that dot our trade routes than the public in general is aware of. The Institution, I am sure, has done good work in directing attention to this subject, and the thanks of every member of the Institution are due to the Council for having given this as the subject of the Essay. I am sure also that the country, if it cared to take any notice of naval questions, would regard its security as improved if it only knew what intelligence and ability its Officers, as shown in these Essays, have brought to the consideration of the matter.

Lord ASHLEY: My Lord and gentlemen, I am loth to take up the time of this Institution with any remarks on my part. We veterans, who feel a great regard for the Service that brought us up and made men of us, although we left it some time ago, would much rather come to meetings of this sort and hear speeches from Officers on active employment; and nothing more proves the great advantage of institutions such as these than to find you, my Lord, an ex-First Lord of the Admiralty, in the chair, and gallant Officers from every part of the globe coming to join in these discussions, and giving their practical and experienced views on everything connected with such a large subject as my friend the Prize Essayist has placed before us to-day. But having heard with great pleasure from two gallant Officers the praises of a body of men I have the honour to command, the Naval Artillery Volunteers, I feel myself bound to say a few words, and let this meeting know a little about them. I am delighted to find my friend in his paper distributes to that force the very duty which I have always urged they are most peculiarly adapted for, which is that of a naval torpedo force: and that opinion is also shared by another old brother Officer of mine, Captain Arthur, of H.M.S. "Vernon," at Portsmouth. These are men always on the spot. They have a certain amount of intelligence. I am proud to say I command a force where every man, instead of getting a capitation grant, pays a sovereign a-year for the honour of belonging to it. That is a point which ought to be considered in their favour as an economical force. They devote themselves entirely to learning the duty of seamen gunners; and though they are like the Marines, not obliged to be sent aloft, yet for mere pleasure they are quite ready to go aloft and furl sails at a moment's notice. There is another point of view in which they would be most useful, that is, as coastguardsmen. I have two detached batteries, one at Brighton, and the other at Hastings. They are all young men of the place; some well-to-do tradesmen, some clerks, but they are all most accomplished boat sailors, and in case of war those men might perfectly well relieve the coastguard; they would be always on the spot; they could, more or less, be looking after their own affairs while they were doing coastguard duty, and would be most intelligent signal men. Those are the sort of men I have the honour to command. I think the country ought to be very proud of their services, and there is no country but England where such a body of men would be found to devote their time for nothing to the service of their country. I am talking to you, my Lord, as a man high in the councils of your country, and who held one of the greatest positions in the English Government, and I will say while I am addressing you, right well have you filled it; therefore I will say that I do think that facilities ought to be given as much as possible by the Government to allow these young men to perfect themselves in the duties of their profession; they are most eager, most anxious to learn everything. I have had several applications from my Officers to be allowed to go through a short course of gunnery in the "Excellent." Of course a short time ago I was met by the objection, "It cannot be done, because we have not got such a "thing as a short course;" but now when greater facilities (and I am very pleased to see it) have been given to all classes of Officers to go through a month's course of

gunnery in the "Excellent." I certainly think a way might be found by which my young Officers might be able to learn the whole of the ins and outs of the duties of their profession. It is a great thing for any country to have such a body of young men; though their services may not be required, still they leaven the country; they accustom the people of London to see young men dressed as bluejackets, voluntarily and without pay, subjecting themselves to discipline, and our discipline is stricter than that of any land volunteer force. I am perfectly certain if their services were ever required they would come forward to a man. No gentleman here can at all appreciate what I felt at the previous discussion on hearing two gallant Officers speak so highly of the corps, because we do try to do our best, and from the smallest bugler to the commanding Officer, our great endeavour, our only pride and boast, is that we are ready when wanted to supplement the naval Service. There is no injudicious swagger about us at all; we simply want to do our duty whenever and wherever it may be required.

Captain PRICE, R.N., M.P.: In the few remarks which I shall offer to the meeting, and in view of the very excellent rule imposed upon us by the Council, that we shall limit our remarks to ten minutes, I would venture to confine myself entirely to that part of the subject which deals with the type of our ships. It would be invidious on my part to say that that part of the subject is more worthy of attention than any other, especially after the very satisfactory speech we have just heard from the last speaker; but I think at all events I may say that if any practical results are to follow from the Essays which have been put before us, they are more likely to be found in this question of the type of ships. When I say that, I do not speak of it from a naval architect's point of view, but from the general principles which should guide us in selecting the type of ship. And I say that for this reason. Naval architects have very justly complained that we naval Officers do not tell them what it is we really want. They say: "Tell us what it is you want. Tell us what results you want to gain from the ships we are to build for you. Tell us the general principles which are to govern us, and then we will put all this into detail, and produce any kind of ship you choose to ask for." Following the hint given by the first speaker, I shall confine myself to noticing one or two general principles which are to govern us in this matter. I notice Captain Colomb in his Prize Essay said he was rather afraid he was going to startle some of us. I do not myself see anything at all startling in his suggestions. I think the whole Essay was based upon a due and proper appreciation of the altered circumstances and necessities of modern warfare.

Foremost then amongst these general principles is that of "steam *versus* sail," because we must get to that first of all. Are we to have sail power in our ships, or is that a thing which is not absolutely necessary? That ground has been so well covered in the Prize Essay, and also by the first speaker this afternoon, that I will not go much into detail about it. But there is one great objection which is raised in many quarters to the doing away with sail power that I think I ought to notice, because, although it has a good deal of a sentimental nature, yet I beg leave to think it is one of the strongest objections which is raised to doing away with sail power, and that is, that many Officers of the old school say, "If you do this—if you do away with sail power in our ships to such an extent as is advocated, the consequence would be you would very much deteriorate the seamen of the Navy, and it is their seamanlike qualities upon which England has relied in the past, and must in the present and in the future." I entirely disagree with the opinions of those Officers. To my mind the seamanlike qualities are not endangered so much by those wonderful extravagancies which so many Officers are so fond of, the crossing of the top-gallant yards, shifting over of stun-sails, reefing of topsails, which are very pretty and useful in their way, but which are better suited for the ship scene in the opera of *L'Africaine*, or as accompaniments to the gyrations of Zazel at the Aquarium. If any one doubts that, I ask them to look to those services where seamanlike qualities are to be found in the field, for instance, to the crews of our small coasting craft, pilot vessels, fishing boats. There you will find sailors to perfection, men who are imbued with all the qualities we want to find in our seamen, activity, pluck, plenitude of resource, and in fact all those things which go to make the seaman proper, that is to say, an individual who on the

sea is thoroughly at home. Now if we are to allow that we may with safety and efficiency do away with sail power in our ships, of course that principle will very much depend upon the efficient carrying out of what Captain Colomb calls the principle of duality in our ships. That of course is a good deal a question for naval architects, but if we only tell them we do not want sails in our ships I will be bound to say that principle of duality will be perfectly well carried out in the ships they are to build us in the future. Now if this principle of duality is necessitated by the altered circumstances of the case, I think it is also very much necessitated as regards our ships and the guns which those ships carry. Perhaps I should be speaking more correctly if I said the principle of duality should be enlarged into the principle of plurality. I think most essayists have agreed it is more essential, to say nothing of the economy of the thing, that we should have a greater number of ships of great strength rather than a smaller number of ships of exceptional strength. One reason why I think this, is that in any invention which may crop up in the future, or in the development of those inventions which are now a matter more of experiment than anything else, we are in a better position to take advantage of that advance in science with a larger number of ships than we are with a smaller number. For instance, there are some modes of attack which are applicable to small ships quite as well as to large. There is the mode of attack with the ram. Every one will allow that two ships costing 250,000*l.* apiece will be much more able to meet an enemy with that weapon than one ship costing half a million. It is the same principle in the development of torpedoes. For a given sum of money we can get more ships capable of using those weapons; we can get a better development of them than we can out of one ship which costs the whole sum. Some have said it is absolutely necessary if other countries come into the field with exceptional ships we must meet them with ships of the like nature. I do not think that is at all the case. I notice that Captain Colomb in his lecture does not allow that that is the case. The proper way to meet exceptional ships of that type is by torpedoes or by gunboats, or rams, and so forth; but it is not at all necessary that because Italy comes into the field with a "Dandolo" that we should put a vessel afloat of the same kind but perhaps of superior armament. I see there is a slight difference of opinion amongst the essayists about the necessary number of guns. Captain Colomb, Commander Noel, and Lieutenant Haye all go in for a large number of moderate sized guns in preference to a few guns of very heavy kind. Commander Noel in his Essay says: "What must appear clear to everyone is that moderately heavy guns can "be carried in greater numbers, can be fired with greater rapidity, and are nearly "equal in range and velocity to the heavier ordnance," and he gives us a very useful table of the comparative value of systems of ordnance, which I recommend to the attention of anybody interested in this subject.

On the last occasion Commander Custance said he did not approve of having so many guns on a broadside as six or greater numbers, and he gave certain very excellent reasons. He said he did not think the means of firing broadsides had been sufficiently developed. I wish to notice that, because last year in this theatre I made one or two remarks upon that point; I did not think, I said, that our means of firing guns in broadsides, either by electricity, or in any other way, had been sufficiently developed, and that it required more attention. I was to a certain extent criticized by a gallant Officer, who said he thought this system had been very much further developed than I was aware of, and that as a matter of fact very good practice was got out of electrical broadsides. The other day Commander Custance told us in his experience that was not the case, and I am rather inclined to think he is right, but he only confirms me in my own opinion, that it is above all things necessary that we should develop this power of firing a great number of guns at any given object efficiently. I think all the guns in a battery ought to be capable of being laid, without the slightest doubt, exactly as one gun, and I believe it could be done by our gunnery Officers, with the help of the naval architects, and those people whose duty it is to put the guns on the decks of our ships.

So then as to the principle that we must have more guns in our ships than we are in the habit of placing, I would like on every ground to say the least number of guns we ought to have in a "fleet" ship at the present day should be six on each side. But if this principle is allowed it will decide several questions. One will be

the question of turret *versus* broadside, because it is quite clear that if we are not to limit the size of our guns, we must at all events limit the number of turrets that are to carry them. You cannot put more than a certain number of turrets into a sea-going ship, and therefore you cannot get the number of guns on a broadside, which I hold is necessary. Then there is another question, that of armour *versus* guns. It is often asked, have we reached the limit in this respect? The other day two celebrated Officers both told us that they could not answer this question; they said, "We must refer you to the civil engineers." I do not think that is at all a satisfactory state of things. In fact I go further, and I say I do not think it is a correct answer, because I do not think we ought to leave such questions to civil engineers to decide. It is for *us* to decide. No one can be more competent to decide such a question than naval Officers. If they say that they must go on increasing the size of their guns, then it is for the civil engineers to go on building guns as large as ever they can, and here of course there will practically be no limit at all; but if we tell them that what we want, rather than size in our guns, is number, and the better chance of hitting our enemy, then we shall have answered the question by stopping this extraordinary growth of guns, and limiting them to guns of an ordinary size. I should myself like to say that a good gun of 25 tons is quite large enough to put on board our ships, and I think the size of our ships and the size of the guns might well be limited by the number which I proposed just now should be put in them. I would say every ship except the very small ones should carry broadsides of at least six guns. I should like to say a word or two about harbour defence. I think the principle laid down by Captain Colomb in that respect is a very excellent one. We do not want large ungainly ships to defend our harbours, because in making these large ships for harbour defence I think we go on rather a wrong principle. We presuppose that we are going to be attacked in our harbours by large fleets from the enemy, that is to say, that there is to be a regularly planned system of attack upon certain of our naval ports. I do not think that is at all likely, and if it is we must meet such attack, not in our own harbours, but out at sea. What we want harbour-defence for is, to stop the predatory raids of "Alabama" vessels. No doubt in war with a great naval country such vessels would be sent out of all kinds; they would dodge about round our coasts, pop into one harbour and then another, and get what they can; but the way to stop such vessels is not by ships of the "Glatton" and "Hydra" class; we want swift ships, of light draught of water, and especially Thorneycroft torpedo boats, and also a regular system of harbour-defence by stationary torpedoes.

Lieutenant SYDNEY M. EARDLEY-WILMOT, R.N.: I feel it somewhat presumptuous on my part, in the presence of so many distinguished Officers and civilians, to offer any remarks, but I cannot help rising to express an opinion as to the award made by the referees on the various Essays submitted to them. In that award I entirely concur; and although an unsuccessful competitor myself, I do not see how any other decision could have been arrived at. I have never read anything with greater interest or pleasure than the Essay of Captain Colomb, not for the various types of ships that he recommends, for there my opinion is at variance with his, but for the general method and way in which the whole subject is treated and worked out. As regards the question of turret and broadside, I think it must be conceded the "Devastation" will be considered the most powerful ship in the Mediterranean squadron, and if she is considered the most powerful ship in the squadron, she is the best type of those existing of a fighting ship. She carries a heavier broadside, has a greater speed, and is able to turn or move with greater facility than any other. I served seven months in Besika Bey, with very nearly the same squadron, and it was the opinion I arrived at from experience of the evolutions of the fleet. As regards the number of guns on a broadside, I am of opinion a few guns of great weight are preferable to a large number of smaller size. Of course therein my opinion is at variance with that of the writer of the Prize Essay. The value of well directed bow or end-on fire seems to me insufficiently recognised. There are numerous circumstances when a well directed bow fire is most valuable. For a case in point, just previous to attacking with the ram, *it* may have the effect of disorganizing the enemy, and *by* creating confusion allow us to attack with the ram with advantage, in the same way that on land we disorganize the enemy with

our artillery fire, and then give the order to cavalry to charge. Something of that nature is what I mean in speaking of the advantage of a well directed bow fire.

Another point which I think is not sufficiently recognised is the ability to move and turn with great facility in a small circle. It conduces to safety in ordinary navigation in a great degree, and would be most useful in a fleet action. I think there is not the slightest doubt if the "König Wilhelm" had been able to answer her helm with readiness, she would never have sunk the "Grösser Kurfürst," because as was told me by an Officer who was on deck at the time of collision, the engines were stopped, and the helm reversed some seconds before the collision took place. Had she been able to answer her helm with rapidity, the disaster might have been averted.

As regards the question of masts, I think anybody who has an opinion in favour of masts for a purely fighting ship will see the *disadvantages* of them by comparison between the "Neptune" and the "Dreadnought." They are both lying alongside one another, the "Neptune" a masted turret-ship, and the "Dreadnought" a ship similar to the "Thunderer." In the "Neptune," we have very heavy masts and rigging, which would circumscribe the fire considerably; they are liable to jamb or stop the turrets, and foul the screw in case of being shot away, to say nothing of being less economical in time of peace in proceeding from one place to another, and also decreasing the amount of coal carried. One of the chief advantages of mastless ships, like the "Thunderer" and "Devastation," is that they carry almost four times as much coal as the masted ship: the "Devastation" carries 1,700 tons, while the "Hercules" and "Alexandra" can only carry 500 or 600 tons as the outside amount. That, I think, is a very important thing, and when we were in Besika Bay, the "Devastation" sometimes had to supply coal to other ships.

As regards torpedoes, my remarks may seem somewhat biassed, as that is the branch of the service in which I am employed, but I think their importance in future naval operations will greatly depend upon the manner in which we train our Officers and men in their use during peace time. That training we endeavour to make as thorough as possible, and we do not fear comparison with any nation in the world. But torpedoes cannot be considered otherwise than as auxiliary weapons, on account of their limited range. A weapon must take its rank according to its range, and we know the most effective range of any torpedo we have at present is about 400 yards, that is to say, a man would not probably feel justified in projecting a Whitehead at a greater distance than that. It is therefore a submarine projectile, with a smaller range than any other projectile, but with the power of doing infinitely more damage if successfully applied. But they must be considered an important item, offensive and defensive, in maintaining that national supremacy which we require, to use the words of the First Lord when on board the "Warspite," "to insure liberty, trust, and good faith throughout the world."

Mr. SCOTT RUSSELL: I should consider it a serious neglect of duty if I did not express my gratitude to this Society, and my appreciation of the labours of those essayists, whose works I have read with great pleasure and profit. I only desire that we should draw all the profit from these Essays which they can yield us, and therefore I have looked over them with the view of seeing in what we can all agree. Now I think we can all agree in the first proposition which is laid down, namely, that we ought to construct our fleets on some systematic plan previously laid down. Secondly, that the Government, once having laid down a plan for the construction of an efficient fleet, should not from whims and caprices be afterwards changing their system from day to day and from year to year. Our attention is carefully drawn to that by Captain Colomb in the following passage:—"England never has yet, and never will be, sufficiently long under the dominion of a single set of minds to carry out a grand scheme of preparation for war in its entirety." "Not a single ship should be built which did not designedly occupy her place in the great scheme of preparation for war. It may be said that these things are not compatible, but I hope to show that we should have to submit to very slight inconveniences in peace time after all, while we gained the much greater object of being ready when war came." Now I am sure you all feel with me, that if our Legislature, so well represented in this room, could be prevailed upon to lay down a systematic construction of fleets for the defence of this Empire we should have gained an enormous advan-

tage which we have not yet gained, in the systematic completion of a fleet. Captain Colomb begins, we must observe, by trying to give us the elements. What are the elements? The first I agree in entirely,—“Let there be four classes of ships, and “only those four.” Now, what is the advantage gained by keeping the four classes of ships. It has not been developed here, and therefore I will venture just to suggest what you gain by four classes of ships. Suppose ten ships of a sort go together in a fleet—we will say there are ten of each class, 1, 2, and 3,—mark the result. If class 1 are all the same sort of ships, with the same kind of manœuvring, how admirably these ten will work together, and how badly they work together if they are of all sorts. Next, if you made this law that these ten ships that are to manœuvre together had all their spars and fittings identical, all their guns identical, all their ammunition identical, and if they had all the parts of their engines and their screws identical, look what a treasure you would have, and how each could draw upon the other when you get into difficulty. Now I am afraid that is one of the things which Captain Colomb meant when he said that “England never has yet, and never will be, sufficiently long under the dominion of a single set of minds to “carry out a grand scheme of preparation for war in its entirety.”

The next point in which he has done a great deal for us is to say how much fuel all our ships shall carry. He has given us the measure of the fuel in the performance of a given number of miles. He says, “the minimum number of miles for “which any one of your four classes should be fitted is—what?—5,000 miles.” Now I think he quite understates the speed for which you should be provided. He says if you provide your ships with fuel to make them do *five miles an hour*, you do enough. Allow me to say that I have had occasion to construct fleets for special purposes, one of those purposes being that they should keep the sea in all circumstances; and what have I found? I have found that if you do not supply them with efficient means for a maintenance of an average of *seven knots* performance you are not fit to keep the sea. I do not think he has given us the fighting speed. I wish he had said what is the one speed at which all classes of ships shall be able to come together, and chase the enemy, or engage the enemy, or perform the manœuvres which are necessary in those circumstances which render extreme speed necessary. I think in cases of extreme speed being necessary that the ships should be able to do one speed, and my opinion is you ought to be able, by wasting fuel for a very short time, to catch your enemy by doing fourteen knots. It is a wasteful speed, but do the fourteen knots at the time when it is wanted, and it won't be wasted if you catch your enemy.

The next point on which he and the other essayists have gone a good way to produce uniformity is this, where you say what guns you want. Now I have often discussed that subject here and I will not discuss it to-day, but I am very glad the result of the discussion and of these Essays is to say, we want in every ship a much greater number of guns than we have got at present. They all say that. Then they all say that a greater number of moderately weighted guns is worth a great deal. I wish they had said that guns of larger diameter to carry more powerful shells and to project them with greater velocity and with a lighter weight of gun were also necessary, but I dare say they thought of that when they talked of reducing the weight. Another most important point is this:—I entirely agree with those who say that a broadside of six guns on each side is the smallest broadside we should carry. It gives you twelve broadside guns. I am also of opinion that a ship of considerable size ought to carry four bow guns parallel to the keel for the purpose mentioned by the last speaker, pointing forwards, and perhaps a couple pointing aft, would be enough for the purpose. We have now as a minimum, as the result of this, something like sixteen or eighteen guns. The “providing of duplicates” I think of so great value that I do not think I need say a word more in its favour. Let everything be duplicated, and, if possible, let as many of the fleet as you can, be *alike*. There is one point on which I beg to say another word. Great manœuvring power has been mentioned as a point of very great importance. Allow me to say I think great manœuvring power a matter of the very highest importance. The manœuvring power of many of our ships is contemptibly bad, and the ease of the destruction of a German ship is a good example to us to avoid sending ships to manœuvre together when we know beforehand that they cannot manœuvre safely.

Now I never, as a practical man, suggest or recommend anything out of my profession, unless I thoroughly know beforehand that it is to be done and how it is to be done: therefore allow me to say that if you wish it, there is no difficulty in making the manœuvring of all your ships take place twice as rapidly as it now takes place, and without any inconvenience whatever, only first you must wish it. I think these are all the points which may be said to concern a ship-builder and an engine-builder, and I would merely add in conclusion one word as the construction of engines. I think you should insist on two things: first, that they should be able to give the highest possible speed at the moment of an engagement; and I recommend that to you for this reason, that the same kind of engine which will give you the highest possible speed with the greatest extravagance of fuel at the critical moment when you want it in an action, is precisely the same as the engine which will when you do not want this extravagant speed and are not prepared to waste this coal, give you the highest economy of fuel and standard of performance.

Admiral SELWYN: While giving all my admiration of their labours to the authors of the Essays that have been written, I confess I fail to appreciate a great many of the arguments therein brought forward. To some points I can give my thorough assent, but on others I fail to see that the arguments which the Officers have brought forward are such as would have been brought forward by them did they know things which are known and can be known to others. One of the things which I am very much disposed to doubt in view of two recent examples of large ships breaking down at sea, and having to be towed in, is the doing away with sail power. I do not like doing away with sail power. I *should* like to do away, to a very large extent, with the resistance offered by the masts, and also the dangers arising from the possible fall of the masts during an action, but there is no difficulty, I think, in doing that without sacrificing sail power. I have worked out the resistance due to the masts and yards, and the resistance due to the rigging. The area of resistance in a first-class ironclad due to the masts and yards alone is about 600 square feet, just one-third of the total resistance, the rest being all due to the rigging. All engineers will bear me out in saying that there is not the smallest necessity for rigging as you understand it; that masts can be properly made to stand perfectly well, and to carry all the sails you require, and yet to offer very little resistance, and to require no rigging as support. You can thus materially reduce the total resistance—I am taking the highest resistance, of 60 lbs. on a square foot, which is that due to a gale, and that gives 53 tons total resistance, *i.e.*, 2,000 square feet \times 60 lbs. = 120,000 lbs.—we can take it down to one-third of that, which is very much less, instead of getting an opposition which would nearly neutralise the effect of the screw in the very best ships. I think the highest I have ever known as to the calculated performance of the screw is a push of 53 tons; it can be brought down to one-third of that; and as we need not expect gales of wind of the force of 60 lbs. on a foot every day, I think it is only fair to calculate it about 30. Take that as the average, and then I shall be able to show to the satisfaction of those concerned that the economical work done in the many years of peace during which the Navy goes about the world is much more worth consideration than has been assumed if you give proper sail power, but if you give jury masts you had better take them away altogether. The instant you begin to diminish the real area of sail which ought to be present in order to propel a given well-shaped ship with the proper velocity, you ought to do away with masts altogether, and trust, as has been said, frankly to coal. Auxiliary sail and auxiliary steam are both fallacies in war ships. Why do not I trust frankly to coal? Because you cannot as yet impress the public mind with the fact that we are wasting half our coal. I have been in vessels that burn 1 lb. of coal per indicated horse-power for 13 years past: land engines have been working steadily and constantly with $\frac{3}{4}$ -lb.—why do you not do it? The thing has been recommended by a Boiler Committee, ordered to be tried by the Admiralty, and yet petty obstacles are allowed to intervene, and to prevent such economies as that from being carried out. The instant you get that economy, the reason for your systematic defence of routes disappears, and you get to the true forms of the defence of routes by large numbers of war ships with a high speed, maintained ordinarily with but little expenditure of fuel, and capable of being doubled the instant you chase or go into action, without danger to your boilers. That is the thing to go for, an eco-

nomical boiler, a boiler that won't blow up, or if it is partially destroyed by shot that won't hurt you; a boiler that you can press up to 250 lbs. on the square inch as a regular thing, and that you can go up to 500 lbs. with, and still remain within one-sixth of the bursting pressure. Then comes the question, what are the ships with which you propose to convoy such vessels as carry your corn supplies from America—vessels of 16-knot speed. You may say let them go slower, so as to keep pace with the convoying ships. You will thereby increase the cost so much that the whole of your carrying trade will go under another flag even without the Declaration of Paris. But unless that is considered, you are talking in the air when you are talking about defending your commerce. Under the Declaration of Paris the experience of all the late wars tells you distinctly what will happen. The instant you declare war, the fleet of the weaker naval Power goes into its harbours and remains there. The commerce which was under your flag, as in the case of the American war, goes to a neutral flag, not because it has any real fear of being taken, but because the insurance rate has gone up in every market on the war flag. You are perfectly powerless to prevent that, and if you choose to abandon the old principle that the way to preserve your Empire is to distress your enemy at sea, where alone you are powerful, you may begin to think how soon you may get rid of your navy altogether, for it ceases to have an object. The object of the existence of a navy is not merely to fight, but to protect the commerce of this country by insuring it to the flag, and to it alone. Your exports have dwindled till you are no longer able to pay for the food you import, except from the returns of your carrying trade, how are you going to protect this commerce on which you now live—that is the question? It is bootless to think of making types of ship when no one can tell the type of engine, gun, or boiler, that you ought to adopt; when daily science is giving us such new and great facilities in this direction, that to make great classes, would be to make great mistakes.

The "Iris" and "Euryalus" were calculated for very high speed cruisers, but unfortunately they have failed to give the ordinary results due to their horse-power, obtained in ordinary cruising ships. No doubt we shall get rid of that by improving some of the details; but it is only by following day after day the improvements of each of such matters in detail, that we can ever hope to arrive at perfection, and science has gone so fast lately that it requires no less than to be watched from day to day. If you thought you had a good gunboat and torpedo boat yesterday by following Thorneycroft's valuable discoveries, you may find to-morrow he has led you perfectly wrong, not in launches, but in torpedoes, and that there are means quite available for you by which you may strike a ship not at 400 yards, but at 1,000 yards, and at one-tenth part of the expense, in one-tenth of the time, and with almost absolute certainty. All these things must be thought of and worked out, and before that is done, it is in vain to rely upon any general plan, however thoroughly systematic. Captain Colomb very well states that the cost of a ship and her efficiency ought both to be taken into account before we arrive at any conclusion as to the value of a particular type. If it be said that we must do away with masts, and must have the greatest number of heavy guns with the least draught, with the greatest power of resistance to shot, and the greatest unsinkability, these are not the types of ships you want; you must go back again. I have here the calculations for a ship which can carry sixteen 80-ton guns, perfectly defended against even the 80-ton gun itself, on a 16-foot draught at 16 knots per hour. All this is to be done by following out the new dicta of science, not by following types which even their builders confess to have been mistakes, types not one of which can go to sea with the original weights which were calculated by her builders on board.

A MEMBER: Might I ask the tonnage of the ship to which you refer?

Admiral SELWYN: 11,593 tons. I am speaking not of my own ideas; I am taking Mr. Elder, a well-known and thoroughly reliable ship-builder, who is, unfortunately, no longer among us. There is a ship of 180 feet diameter, 16 feet draught, and 11,593 tons. She requires no width of armour; the edge of the vessel can be protected with 24-inch armour, and the deck of the vessel with 4-inch armour at an angle at which no shot can strike her with effect. The bottom might equally be protected with 4-inch armour over an area 20 feet wide from the edge towards

the keel, and she can go into 16 feet water, which makes her a proper, well-devised coast defence ship, better than any fort, as of course instead of screws she had a hydraulic motor, as Mr. Elder proposed. She is thoroughly fit for our friends of the volunteer naval artillery to go on board to exercise their skill near the coast, while she could also go to sea and do very good work in moderately good weather.

Mr. SCOTT RUSSELL: You mean a circular ship?

Admiral SELWYN: I mean a circular ship. I do not mean to say Mr. Elder would not have gone further than a circular ship had he lived, but what he did appreciate is the power which a segment of the sphere gives us of capacity and steadiness, and which the turbine gives us of keeping a ship above water, however damaged, and steering in any direction without a rudder. I think three of the essayists distinctly say that there is something in the hydraulic propeller which we have not got anywhere else. Is there any reason why at least this Institution should not be in possession of the records of the real sea work of this turbine propeller? I do not know any. I believe it would be greatly for the benefit of the whole profession that we might appreciate those causes which in the very first large application of the system, gave nearly an equality to the screw propulsion which has been under consideration and improvement for the last forty years. If we had a leak thirty feet under water of ten square feet, we should be able, with 1,300 horse-power, to keep the water from entering that ship at all when she was at rest. If the leak was aft and she was kept going, of course there would be less water to enter, and *vice versa* if it was forward. When I tell you that by the adoption of boilers which can be worked to double their ordinary pressure, you could at once double the power available in such a crisis as that, I think we have some good sound ground for serious inquiry, and that we ought not to be content with forming ourselves into a Mutual Admiration Society and saying everything done was done as well as anybody else's. I do not like that line of argument, it is one which would put a stop to all progress. We have tried the double screws, which I was the first to call twin-screws in my advocacy of them with Captain Symonds at the Naval Architects' years ago, and they have done well; but I now say we can go further and do better. Why do we not do so? Because everything is kept long in the background that does not square with ideas generally accepted. Our business is to bring forward views which, though good, are not generally accepted: and if an argument put forth in this theatre cannot stand the fire of discussion, I am quite sure it is not worth listening to for a moment.

The CHAIRMAN: I trust I shall not be presuming too much upon this meeting if I request leave to touch as briefly as I possibly can on some of the remarks and observations that I have heard in the course of this discussion. I almost feel, as a landsman, I am guilty of something like presumption in desiring to do so; but, as you know, I have taken from natural taste and official position such deep interest in naval affairs for many years past, that really I almost feel as if I was entitled to do so. I cannot refrain from expressing my very great pleasure at finding this Institution devoting its attention and its energies to promoting such admirable discussions as these are. I think it is impossible for professional gentlemen—men of eminence in their different walks—to assemble here together to discuss these Essays, and to express their opinions, without great national benefit, and without to a great extent achieving what I presume really to be the main object of such meetings as these, viz., as far as possible, to arrive at practical conclusions. That is the real value of such discussions as these. I confess that there are some points connected with this great and important subject that I am sorry not to have heard discussed rather more fully. I should like to have heard more about torpedoes. They have been adverted to by the able writer of one of these Essays, Mr. Eardley-Wilmot. I think Captain Price also briefly adverted to them, but I confess I should have liked to hear more about these torpedoes, which I think it is quite evident will become shortly an important element in all our naval warfare. Another point I should like to have heard a little more about is the value of the ram. It was rather wittily said to me the other day, after that dreadful accident off Folkestone, that at all events there was some consolation in finding that we were not the only nation that ran down our own ships. Notwithstanding this remark, and notwithstanding the unfortunate fact that there has been some reason for that remark, I think we must feel here about the ram as much as we do about the torpedo, that it will form a very important element

in naval warfare hereafter; and I confess I was glad, and I think every one here was glad, at our last meeting to hear from the high authority of Admiral Ryder, a tribute so justly paid to that venerable and gallant sailor, Sir George Sartorius, as being, I think we might call him, without exaggeration, the originator of this valuable element in naval warfare.

There is another point that has been scarcely touched upon. I find in Captain Colomb's Essay this sentence:—"Not a single ship should be built which did not distinctly occupy her place in the great scheme of preparation for war." I think this is a valuable dictum in which we must all entirely concur, and it leads me to that question which has scarcely been touched. It seems to me an important question—the classification of our ships; and I think after the way we have been going on year after year, trying fresh experiments every year, it does seem to me the time is coming, if not come, when we ought to come to some understanding about what the ships really are to be. Really I cannot help remarking I am rather struck with an expression which to me is a novel one (I do not know whether the Admiralty has sanctioned it), but Captain Colomb, in his proposed classification, and I think some other of these essayists, describe one class of our ships as "fleet" ships. Now whether the Admiralty have sanctioned this term I know not, but if I may speak as an unlearned landsman, I think the term "fleet" ship no doubt will be perfectly understood in this room by naval Officers, but I am afraid out of doors you will find 99 men out of 100 will think when you talk of a "fleet" ship, you mean a ship that can go very fast through the water. That will be the inevitable conclusion out of doors, and I confess I cannot see why we should not call our grand ships of the first magnitude line-of-battle ships, as in former years.

There is, again, the question of "coast defence" and "harbour defence," and here it struck me that there was a little confusion between those two things which do not seem to me to be identical at all. It seems to me that coast defence is one thing, and harbour defence another, and that for harbour defence you will inevitably require a large class of ship, not equally appropriate for what I should call coast defence.

I was heartily glad to hear so high an authority as Commander Noel saying, without any contradiction, and I hope there is none intended, that the training of our sailors never was so good as at present. That is a most gratifying statement, and if it is to be accepted, as I hope and trust it is, then you come to a most important practical conclusion. The same thing with regard to the Naval Reserve. I was very glad to hear the very high terms in which Captain Verney spoke of our Naval Reserve. It has been laid down with emphasis that we must think of attack as well as defence. I thought the remarks we heard on the former day were very sound and good, that the object of all our ship-builders, and of all our efforts on this subject for a considerable length of time, have rather been too much in the direction of considering how we were to be safe in our ships than in considering how our ships were to cause destruction to the enemy with whom we have to grapple.

There is another question raised to-day which I confess I was very glad to hear discussed, namely, the great question, are we to abandon canvas? I was sorry to hear so high an authority as Captain Price speak in such decided terms, that sail power is obsolete, and I was very glad on the other hand to hear my gallant friend, Admiral Selwyn, take an opposite line.

When I came into the room I heard Captain J. C. Colomb give us statistics of the number of millions of quarters of corn that within a given number of years had been imported into this country, and I really for a moment thought I had come to an agricultural meeting, and that instead of the question how we were to plough the sea, we were considering how to plough the land. There is, therefore, one question I should like to ask Captain Colomb. He says there were 370,000,000 quarters of corn imported within seven years. What proportion of that corn imported came under canvas and what proportion came under steam? I do not think myself (I confess I speak ignorantly) but I have a very strong impression that we cannot afford to do away with sail power. I should be very sorry to think the day was coming when we should attempt to do away with sail power, and I see no reason why in this respect we should not look to the continued use of both canvas and steam. They both have their value for the purposes of commerce and war.

You will find the steam engine must be maintained, and I hope and trust the canvas will be maintained also.

I will not detain you longer, but before I sit down I will once more congratulate Captain Colomb on the success of his very able paper, which has been in fact the text for this very interesting discussion, and call upon him for his reply.

Captain COLOMB, R.N.: My Lord and gentlemen, had I not been called upon I should have considered that at this late hour of the afternoon silence would have been golden on my part; but having been called upon, I feel I must respond to the request of the Chairman, and I shall endeavour to confine what I have to say to as few words as possible. As Lord Hampton addressed us before my remarks came forward, I think it is only proper that he should have first place in my reply. The term "fleet-ship" is in no way authorised by the Admiralty, so his Lordship was on quite firm ground when he objected to it. It is my own term. I am fond of short words, and so far as I can see we refuse to re-adopt in the Navy the term "line-of-battle" ship. It has gone out, and there seems to be no power of getting it in again. We want a term which will express shortly and clearly that for which the present ironclad is meant, that is to say, to fight and sail in a fleet, and such a ship I had called a "fleet-ship." But it will not be such a misnomer, because at the present moment these ships are the fleetest ships, and I suppose will remain the fleetest ships we have; so that I hope, if the term holds, the "fleet-ship" will be represented in both senses.

I was much struck by the distinction the Chairman drew between coast defence and harbour defence. I am not quite sure that I ever thought about it exactly in that light before, but I think it is a point we ought to turn over in our own minds to see whether it is not one which we have been rather missing out. As to the *offence* and *defence* of the fleets, when I say our Navy should be defensive, I mean defensive in the sense that it should be capable of resisting attack; that is to say, its business is to keep the sea clear, to fight on the sea, and that its greatest defensive power will consist in its offensive power. What I mean to say is that our Navy should not be devoted to make attacks upon the enemy's land, and that we should not throw away money in making attacks upon the enemy's coast in using the Navy as a directly attacking force, because the only way in which history shows how a real injury can be done to the enemy's coast is by the Army, and that the Navy is usurping its place when it takes that office. I am quite certain I and my brother essayists have felt very much flattered at the way in which the speakers and the Institution have received our efforts. I very strongly confirm what Admiral Hamilton said as to the value of these Essays. It is not alone the value of the Essays themselves, but that the writers of them benefit themselves and indirectly benefit the country afterwards. They take views of subjects and acquire information which, if they did not write these Essays, they would omit to do.

I must confine myself in what I have to say entirely to the material questions. It would be impossible for me to enter into the numerous heads and to make no division of the subject. I will cut off altogether the whole of the questions relating to *personnel*, and will touch nothing except the question of *matériel*. The whole of my scheme from the beginning is founded upon my brother's writings and upon his conversations with me, who, some twelve years ago I think, put this view of general naval policy into my mind. It is known to most of you how much he has written on the subject, and I am perfectly certain my Essay never could have been written, had it not been for the broad statesmanlike principles he laid down. I have merely followed in his footsteps and put into naval form the part of his scheme which really belongs to the Navy. We naval Officers, when we lightly form and lightly utter light opinions, often think it does not matter. Now the youngest of us has an influence on the acts of the Admiralty. Everything done at the Admiralty, everything done by the naval architect, whom we so roundly abuse, has come from us in the Navy; and if the naval architect makes mistakes, and if the Admiralty in their administration make mistakes, it is from the active service of the profession that those mistakes have originally arisen. The Admiralty (and I am quite certain I am right in saying it) initiates nothing. Everything which is done at the Admiralty, every movement made, comes from the pressure of the active service, and therefore the opinions expressed in this Institution have a weight which is not usually credited

to them, because its effect is silent and underground. But the weight is there, and the results come forward sometimes in places and shapes which are most unexpected to us.

My friend, Captain Dawson, opened the discussion with his usual vigour. Now there are men who might object to a strength of language which, in his case, is merely an association of a strength of intellect which has been known to me for something like thirty years; and therefore, however strong his language might be, I could never listen to it without getting some good from it. He found fault with me for misquoting history. Well, at the time of course I submitted to the lash and took my snubbing in the best way I could; but I was bound to see whether I was really making a mistake or not. The question was, whether I was right in stating the "Harbour Defence Idea" built the "Cyclops" class. The speaker said that in point of fact the "Cyclops" class was built to go out into the Atlantic to fight a battle and come back again. Captain Dawson mistook on that point. I have been to the Report of the Committee on Designs to ascertain what the actual facts were, and I find that Captain Dawson was mixing up the "Thunderer" with the "Cyclops" class. The "Thunderer" class, the "Devastation," "Dreadnought," and so on, were built for that exact purpose.

Captain Dawson: I specified the "Glatton."

Captain COLOMB: I will take the "Glatton" in. The words are these as to the "Cyclops" class, and the "Glatton" is included:—"The first ships of this kind designed for the Admiralty were the 'Cerberus' and 'Magdala,' the former for the defence of Melbourne harbour, and the latter for the defence of Bombay harbour. With this latter is associated the 'Abyssinia.' . . . The 'Cerberus' and 'Magdala' are sister vessels, and the new 'Cyclops' class are almost identical with them." Then the Constructors go on to say—"We therefore consider ships of the 'Cyclops' class and the 'Glatton' are fitted to defend harbours and rivers on the coasts of Great Britain, and to make passages from port to port in favourable weather. They may possess greater sea-going qualities than these, but with our present experience we are not able to satisfy ourselves that they do." All I want to say is, if we now condemn this class of ship, we did not condemn them when they were built. We asked for this particular defence ship. We were mad about the American monitors, and from our vague ideas in the active service, sprang those ships which we now condemn. But whether we condemn or do not, there is one thing quite certain, which Sir Walter Raleigh said for us:—"And to say the truth, a miserable shame and dishonour it were for our shipwrights, if they did not exceed all others in the setting up of our Royal ships, the errors of other nations being far more excusable than ours." And that is just as true at the present moment as it was 298 years ago. When Captain Bridge advocated harbour defence, I think he omitted the question of cost; and the question of cost is one I always wish to impress most strongly. It is not a question whether you shall have harbour defence, or whether you shall have sea-going ships, but the question is, given a sum of money, when the Admiralty meet to discuss the estimate, when the first Estimate Board meets (I am not in the secrets of the office, but his Lordship would correct me if I am wrong) I have no doubt whatever that either in the shape of *pourparlers* or of sitting to discuss round the table, the first question is "How much will the Chancellor of the Exchequer stand this year?" Therefore, invariably, when you come to questions of naval policy the first thing is the money. [The CHAIRMAN: There is another question, what shall we do with it?] After you have got it, the question is how much can you afford to spend on each kind of defence? As his Lordship says, what are you going to do with it? It is not any use to say "We will have both." You must be content with one. Lord Hampton very strongly condemned my position that the steam must take the place of the sail. Now, I know very well indeed, and I very much feel that the proposition is very largely condemned, both by statesmen who have had to do with the Navy like his Lordship, and also by my brother Officers on the active service. I know quite well that for the time I am looked upon as rather a dangerous innovator, but that question was discussed in full here the other night when I read a paper in order to prepare for the present discussion, and then Sir Spencer Robinson gave up *in toto* the idea of sail power for the ironclad.¹ The essayists

¹ See "Journal," Vol. XXII, No. 96, page 530 *et seq.*—Ed.

have done the same thing, and a great many speakers have also done the same thing. I do not at the present moment know anybody who, when pressed upon the point, says "keep the sail power for ironclads." How much further it may be carried I cannot of course pretend to say. It was my duty in writing the Essay to carry out a distinct principle for the purpose of eliciting discussion, and I do not feel that I am distinctly bound to say—if other facts come before me I cannot say—we will not keep the square sails for certain classes of ships. I can only say that those facts are not before me now. Now, in these things, when a point has come to the surface, if you have the right ground, it is surprising how you get confirmation. Now we had confirmation in the most recent experiment of war we have had, the action between the "Amethyst," the "Shah," and "Huascar." We have the despatch of the Admiral in command of the ship. She is a full-rigged ship, where sail power has reached its highest development, and she is in that very part of the world where I do not quite see how sail power is to be done away with. Now, what is his trouble? He says, "The 'Shah's' coal supply getting short, now began to be 'a serious consideration, but trusting to getting some coal either at Pisco or Iquique, the two ships at once started for the latter place.'" That is to say, apparently, *they quitted their chase of the "Huascar" in chase of coal.* I do not think it would be possible to put forward anything stronger in confirmation of my views than that. These views have been gathered from an investigation of the results of 50,000 or 60,000 miles travelled over by three of Her Majesty's ships, the "Audacious," an ironclad, the "Egeria," a single lifting screw sloop, built specially for sailing, and the "Hart," a twin-screw sloop. The "Audacious" total gain on the credit side without anything to the other side, was only 7 per cent.—she only got 7 per cent. advantage from the use of her sails—the "Egeria" only got 25, and the "Hart" 26 per cent., and they got that high percentage because it happened that they ran for 8,000 miles each of them before a strong fair wind. If they had had as much wind against them as they had with them, their further progress showed the fall would have been down to 5 per cent. Admiral Hamilton in a former discussion gave the answer which seemed decisive. He said, "I was in a 'ship, I got on shore, and had to throw the whole of my coal overboard to save my 'ship. Where would I have been if I had not had my masts and sails to get back 'to the harbour with?' The answer is, 'You would have simply kept the weight 'of your masts and sails on board in the shape of coal, and could then have steamed 'away to your port.'" It came to the same thing. Captain Crozier spoke of the necessity for sail because of his experience in the "Waterwitch." I never proposed to do away entirely with the sail power. Captain Crozier in the "Waterwitch" would have had, I think, the auxiliary sail power which he used.

When we come to the question of "turret *versus* broadside," you get an answer which I must say I always feel uncomfortable about. You get the general reply from the naval Officer, "I want both." There, I say, is the trouble! We ought not to make that answer; we ought to think it out, and to say for ourselves which of these two things is the best, because both you cannot have. There are, of course, immense numbers of questions involved, many of which have been discussed. There comes the relative advantages of beam and end-on fire, and also of many light and few heavy guns, which have been discussed, but the point again is, supposing a man says, "I must have my end-on fire"—several speakers have gone for it—the question is, "what are you going to give up for it?" In the "Audacious," you gave up 100 tons for that purpose; you would have had the same number of guns on the broadside under the same plating for 100 tons less weight. The question is not will you have broadside or end-on fire, or both, but what are you prepared to sacrifice? Is it worth 100 tons weight? When you have only 300 tons of guns, are you going to add 100 tons to your weight for the purpose of putting two of those guns to fire in a line with the keel forward, and two more aft?

MR. SCOTT RUSSELL: Certainly; add another 100 tons of buoyancy to the ship.

Captain COLOMB: Then you immediately come to the money question. We have again the practical experiment of the "Shah" and "Huascar," but it has hardly been adverted to in a way to make it useful. Now what happened on that occasion? The "Shah" and "Amethyst" fought the "Huascar" at

distances varying from 300 to 1,900 and 2,000 yards. Now the "Huascar" had two heavy guns, and the "Shah" had two heavy guns. The "Shah" had also 16 heavy guns of a smaller calibre than either of the "Huascar's" large ones, or the "Shah's" large ones. They fought for 2½ hours. At the end of that time (comparing all the accounts that have come forward) I find that this is the measure of the damage done to the "Huascar." She was hulled by four 9-inch projectiles, and two 7-inch; she was struck in various places by eight others, of various calibres; four went through the funnel, therefore you could hardly say she was hulled in that case. This leaves you nine shot which struck her, and of course some of the 64-pounders, but they are not specified, and there is no means of ascertaining whether the abrasions of the iron were due to the broken pieces of shells, or to projectiles directly fired at the ship; but numbers of them were certainly ricocheted. She was, however, struck nine times, and practically she was not much hurt; she had one man killed and one wounded. What was the expenditure of ammunition over that piece of business? The "Shah" fired 241 shot, 32 9-inch and 149 7-inch shot and shell at the "Huascar." The "Amethyst" fired 190 shot at her! Now, on the other hand, the Admiral expresses surprise and thankfulness that the "Shah" was not struck by the "Huascar's" shot. The "Huascar" appears to have fired eight times at her. Now considering that out of 431 projectiles only nine took effect on the "Huascar," I do not quite see that it was a matter of surprise that no shot out of eight struck the "Shah." These are the actual facts and figures of the case; there is no question about it; I have taken out the figures myself. But I want to guard myself against one thing which I know will be said to-morrow. It will be said, "You are throwing a reproach upon the gunnery of your own ships." No; I am quite satisfied the gunnery of our ships is the best gunnery in the world, and I have no doubt everything was done that was right in both those ships of ours on that occasion; but here is the strange part of the business, that the percentage of shot which took place is nearly the percentage which I stated some years ago in this Institution would take effect. The articles in the papers when the news of that action came home were strong in expressions of surprise how little had been done. I said, "About 2 per cent. of your shot will strike your object in action," and there is the whole thing. But now the point is, what good (after all said and done on this particular occasion) were the "Shah's" two heavy guns to fight a ship not of her class, an armoured ship like the "Huascar?" And that goes to support what Captain Price, and what I am glad to find most people who have gone some distance into the figures with me come to, that practically one or two guns are not much good in any case whatever, that the inaccuracy of fire is so large an element that it is not much use having so few guns, and that unless you can show a broadside of some six guns, you do not get much value. You cannot do much with it, your shot is thrown away. And then you come, of course, to a something definite about this question; when you can get at the percentage of hits, and when you can make an equation between what number of hits you are likely to make, and what number of guns you can put on the broadside, to make up for the deficiency of the number of hits.

The classification of ships which his Lordship pointed out was one of the most important parts of the whole matter, and yet has not been fully brought out. But the difficulty really is, that there is so much to speak of. I won't say one word about the classification, because I have really said all I have to say, in the paper itself.

Reverting for a moment to the question of the few heavy or the many light guns, and going to that further question, should a ship be armed to fight one of her class, or to fight every other ship, I was a little surprised to hear Captain Scott take the latter view, because I do not think it is one that is coming to the front at present. I think naval Officers are beginning to understand that that is not so; and I think if we imagine the "Shah," armed with two or three heavy guns, an unarmoured ship on purpose to fight a ship like the "Huascar," meeting another "Shah" of her size with three or four times as many light guns, I think we should feel that the "Shah" was not properly armed, because the very first action between those two ships would utterly defeat, destroy, and demoralize the "Shah" with the few

heavy guns, while the "Shah," with the many light guns, would have become triumphant. It would have been no disgrace to a ship to have been beaten off by a ship that she was not intended to fight, but it would be a lasting and burning disgrace, and destructive to our prestige, as it was in the American War, if she were beaten by another ship of her class. The people of this country would not go into the details of the nature of the guns; they would find the ship was of a certain size, and of such and such a class, and if she was beaten, there would be the same outcry that there was in the American War.

We have to thank you, my Lord Hampton, for taking the chair. I am quite sure the service is grateful to you, and the Institution especially, and I am myself very grateful to you for the keen interest you have shown, and for the appreciation you have manifested by your personal remarks, showing that you have thoroughly grasped the points that have been laid down.

LECTURE.

Friday, April 12th, 1878.

LIEUT.-GENERAL SIR GARNET J. WOLSELEY, K.C.B., G.C.M.G.,
&c., &c., in the Chair.

ON THE INFLUENCE OF BREECH-LOADING ARMS ON TACTICS, AND ON THE SUPPLY OF AMMUNITION IN THE FIELD. PART I.

By Colonel EDWARD CLIVE, Grenadier Guards.

It is about six weeks since I was asked to read a paper in this Institution upon the breech-loader and its requirements.

In looking up the subject, it presented itself to my mind strongly in two ways:—

- (1) The helplessness of the arm when short of ammunition.
- (2) Its formidable properties in attack and in defence.

The first subject, then, for consideration was the supply of ammunition, which entailed a comparison between our system of supply and that of Continental nations.

The second was the value of the arm as a means of attack; but as this could not be fixed without considering also the rifle with which the enemy was armed (which must be assumed as good as the weapon of attack), I found myself unable to proceed without considering the tactical formation in which such an arm could be best approached.

While so engaged, I read and re-read many works upon the last German war, as well as critiques and reviews in French and German newspapers, which served to confirm views upon tactics which I have for some time held.

Feeling, however that these views might be dissented from by many, besides necessitating a comparison between our organization and tactics and that of other nations, which would require more time than I could conveniently spare, I still hesitated to bring them forward, even as personal opinions; but upon reflection I determined to do so, for the following reasons:—

Many of the works that I refer to, such as those of von Scherff, von Boguslawski, von Verdy du Vernois, and of the late Captain May, have been translated into English, and are not only largely read throughout the Army, but are largely quoted by distinguished officers; and even form text-books at our military schools, colleges, and academies, and the arguments and views advocated in those works are now used in the daily newspapers. Under these circumstances, I think it better that the questions under consideration should be fairly raised, if possible, in a Military Institution such as this for discussion by professional Officers, than that they should be fought out anonymously in the public prints.

I have therefore availed myself of this opportunity of submitting my personal views on these questions, in the hopes that, if the Council of the Institution can spare another day after Easter, I may be allowed to conclude the subject, and we may have a worthy discussion upon the great questions of the day—a large or small tactical unit, and the best form of attack for Infantry.

It will simplify our discussion if I state at once the framework of the lecture.

- (a) I shall first inquire into the elements of a good fighting formation, and show their bearing upon the size of the unit.
- (b) Examine the character of modern fighting in order to ascertain the part the unit has to play.
- (c) Quote passages from German and French Field Exercises relative to the instruction necessary to render the unit efficient and capable.
- (d) Consider our own attack formation.
- (e) Give examples from the campaigns of 1870 and 1877.
- (f) And from the above deduce the four conclusions which I submit as the basis of discussion, viz. :—

With reference to the size of the unit,

- (1) That we require a smaller one than the battalion.
- (2) That the most convenient size is one 200 strong: and, with reference to our attack formation,
- (3) That it is inadvisable to elaborate any fixed drill for the attack of battalions of the first line.
- (4) That the only instruction relative to the attack, in peacetime, should be that of general principles combined with study, practice over varied and strange ground, and the criticisms of experienced Officers.

Although I do not expect to make any converts, I hope that at all events the evidence which I shall bring forward will be considered sufficiently pertinent to justify me in raising the question at this Institution, and in directing the attention of Officers to these matters.

a. If it be not considered too elementary, I will occupy a short time in explaining the tactical difficulties of elaborating a good fighting formation.

I commence by assuming two principles to start from:—

- (1) The front of extension or attack formation shall cover the front of the battalion in line; and

- (2) The attack shall consist of three parts, skirmishers, supports, and reserves, in the following proportions, viz. :—

Skirmishers	..	..	..	$\frac{1}{3}$	battalion.
Supports	..	..	..	$\frac{1}{4}$	„
Reserves	..	..	..	$\frac{1}{2}$	„

And as we may fix the battalion at a strength of 800 men, occupying a front of 300 or 320 yards, we can start by saying that 200 men in the first line will cover the battalion front; 200 men will support them at a distance of 150 or 200 yards; and the rest of the battalion will act as a reserve, about 250 or 300 yards in rear.

Now, what are the essentials of a good fighting formation?

It must have a large front of fire. Its leaders must be skilled in tactics, in observing, and making the most of the features of the ground, both in order to shelter the men, and also to bring a concentration of fire upon certain points of the enemy's position, and above all, it must be under control: that is, it must admit of being directed from the rear by the Lieutenant-colonel and the Captains, and the discipline must be good enough to ensure orders coming from the rear being obeyed by the leaders in the first line, or as Colonel Home in his *précis* of tactics expresses it—

The formation most suitable for the attack is one which will give Commanding Officers means of feeding the front.

The area of action of a Commanding Officer will be as long and far deeper than it formerly was.

Such a power of direction can only be achieved by organization, discipline, and practice; and although I do not believe that so great perfection is possible of attainment under fire, yet I am satisfied that the more we strive after this ideal, the more perfect will be our form of attack.

The power of direction resolves itself therefore into—

Organization, or the division of the troops into units of a convenient size.

Discipline, or the obedience and deference which troops pay to the orders of their superiors.

Practice in peace of war-tactics.

Commencing then, over how many units can an Officer exercise an efficient control?

A corps commander controls	..	..	3 divisions.
A divisional „ „	..	..	2 brigades.
A brigadier „ „	..	..	3 or 4 battalions.

And upon these premisses we may suppose that a battalion-commander could control 4 units, and if he have the assistance of 2 majors, 8 units.

Having fixed this point that the Colonel can command either 4 or 8 units, what considerations govern the size of unit, which for simplicity we will call a company?

The Captain's means of control being limited by the voice, whistle, or signal, if the company has to find its own skirmishers, supports, and reserve, it follows that it must be of such strength, that its front in

line shall not exceed 70 or 80 yards, and when in attack-formation, the line of skirmishers covering the front of the company, will be within the effective control of the leader of 1st line.

Upon this reasoning the strength of the company would not exceed 200 or 250 men if an efficient control of them is to be ensured. And as I may assume that no one will wish to multiply links in a chain of command without reason, we may say that 200 or 250 men being the maximum, 100 men as in our service will be the minimum strength, and the question for decision is, which is the better sized company for the purpose for which it is required?

It so happens that while the Continental nations have the larger company, we have the small one, and we have therefore only to compare the relative advantages and disadvantages of each.

b. For the larger company, the materials that are available for evidence relate to the war of 1870-71. The details of the present campaign are not yet to hand, if indeed they ever are published, which is by no means certain, considering Russian secrecy on the one hand, and on the other that the Turks have probably made no reports and kept no journals. But in relying mainly on the war of 1870, we find not only accounts from both sides in great detail, but that these very accounts have generated a considerable amount of criticism by able Officers to which we may well refer for accurate and well considered professional deductions from the events of that campaign.

Captain May in his "Tactical Retrospect," and Major von Boguslawski in his "Tactical Deductions," have viewed the results of the campaign of 1866 and 1870 with great care, and the reception their books have met with throughout Europe is the best testimony to their value.

Thus Boguslawski says, page 85, of the 1870 war:—"From the first action of the campaign at Weissenburg, until the end, the fights for localities were more frequent and more desperate than in 1866."

"These fights for localities happened necessarily often because skirmishing tactics attained a greater development in this war than they had ever done before, which tactics entail the necessity of taking every advantage of the ground, great and small." And in summing up the characteristic points of the Infantry Battle Tactics of 1870 and 1871, he says:—

"We did see great deployments of skirmishers on both sides, long continued gradually advancing musketry fights, often rolling backwards and forwards; at last the flank of one party turned on one side exhausted, the other side pressing on in consequence, or a rush of dense clouds of skirmishers who endeavour at any price to dislodge their opponents, not forgetting that in case of failure or retreat they are dead men.

"On both sides great dispersion and intermingling of troops, particularly in broken ground, hence the leaders' control diminished."

"Great clouds of skirmishers and small tactical units, that is the form for infantry. 1859 and 1866 showed the truth of this axiom as applied to actual operations on a large scale, 1870 has confirmed it, nay, it has proved that the action of breech-loader against breech-loader has increased the employment of skirmishers in action."

"All idea of attacking with large compact masses, or of drawing them up in line to fire on one another is finally exploded."

See also, a long extract, pages 161 and 162, ending, "The only way to create this battle discipline is to take great pains with the individual instruction of the soldier and to practise extended order, fighting in a larger and more varied manner."

"We have, since 1854, divided our skirmishers into groups because we wish—

"(1) To control the fire by Officers and non-commissioned officers.

"(2) To prevent the men from different corps from getting intermingled.

"Let us therefore practise skirmishing in masses composed of a perfect medley of men as much and as often as we practise Light Infantry drill with our regular sub-divisions."

At page 167 and the whole chapter, again at page 169, Boguslawski says: "How can we hope to manœuvre satisfactorily with a mixed body of skirmishers, if this state of things is quite a novelty to the men? Therefore, we repeat, we must have practice in disorder."

And one last extract, the last but one of the book: "For soldiers to be able to make a rapid change of formation, to extend quickly, to rally speedily, to be able to fight under all circumstances, whether under their own officers in the usual tactical connection, or mixed up with men of other corps, under strange officers,—these are the cardinal points of our tactics and training. We can only attain this standpoint if we speak out quite clearly in our instructions and regulations upon the nature of the warfare of the present day, and if we banish from our field exercises and manœuvres whatever is not in keeping with it." Boguslawski says in effect—

"By discipline ensure your power of control, and by instruction in peace time teach the men to extract order even from the disorder which is inseparable from the necessities of the case."

c. Let us turn to the German Drill Book of 1876 and see how far von Boguslawski's¹ principles are attended to.

The establishment of the German battalion on war strength is 1,000 men in four companies standing in parade order in three ranks—the rearmost being formed of skirmishers. When formed for drill or manœuvre the skirmishing rank forms up as a skirmishing division.

The battalion in action with especial regard to the extended formation, and the use of the company column.

The skirmisher is in most cases left to himself; previous instructions for fighting in closed formations do not apply to him. He must have decision—bodily and mental advantages—with skill in use of the rifle.

These qualities are not found in every man. It is the duty and special aim of the foregoing instructions so to train skirmishers that they not only know their rifles and are active, but have also power of discernment and self-reliance, without which they cannot play their proper part on service.

They must be taught to move freely and actively: and there must be no question of dressing—post—carriage of arms with them.

¹ "Exerzir Reglement für die Infanterie." Chap. xvii. Edition 1876.

They must be taught how to obtain cover from small or single objects—to observe the ground for this purpose.

But the attainment of covert must not interfere with their special objective, viz., the annihilation of the enemy.

The skirmisher must be careful to conform to the movements of the line. Must know himself to be better than one cavalry man—need not fear several.

In enclosed country dressing is out of the question—but lateral communication must be preserved—One section extended, the other as a fire group for the better control of the skirmishers.

In wheeling the dressing is by outer flank, the cohesion and distance to the inner flank.

Reinforcing, Prolonging, Reducing, and Relieving a line of Skirmishers.

A line attacked on the march will only require reinforcing when it meets such resistance as compels it to halt. As a rule the support will *prolong* the line:—

In reducing a line, the party called in must be named, withdrawn at the quick time, the others extending so as to occupy the space vacated.

For the sake of unity of command it is ordered that in reinforcing or withdrawing part of a skirmishing line the original division and sections shall not be separated if it can be avoided, and in any case not mixed together.

In rear of every line, a formed body must be placed as support. The company is the support for the division. Further reinforcements may be necessary, but one section must be left unextended.

Dressing is not worth sacrificing the smallest advantage of ground for.

In open ground and a line of several divisions, one is ordered to direct; in enclosed ground, each Officer must keep his men in hand and pretty well closed, lead it according to circumstances, and without giving up cohesion, keep the objective in view.

In all movements the skirmisher must never forget his attention to his Officer or under-officer.

A small whistle is allowed.

Directly reinforcing a line with fresh troops or files is inadvisable, as men of different bodies get mixed and the command is made more difficult; in any case the skirmishers must close in to allow of the reinforcement coming up on the flank or centre *undivided*.

It is impossible to give any rule for posting skirmishers and manœuvring them, and it would only lead to crippling the intellect of the leader, to whom alone it must be left, who in each case must choose such means as will enable him to accomplish his object with the least loss.

Above all, the fundamental rule is that skirmishers are only supported by men of their own company.

This must be the practice at drill to accustom the leaders of troops to act accordingly; especially is it most important in enclosed ground.

I have only taken a few paragraphs, but there are yet about four more which seem to me so good and so telling that I may be excused for troubling you with them.

They relate to skirmishers, leaders, and Commanding Officers.

No more skirmishers are to be extended than are necessary for the strength of the enemy, unless it is wished to obtain a rapid result.

A skirmishing line is well placed when not only each individual reaps the utmost advantage from the features of the ground, but further, when the important points are strongly occupied, and the weak points defended by cross-fire.

In addition to the greater or less importance of the part played by skirmishers in battle, and the difficulties which the direction of large bodies entails, not only is the expected perfection of the individual most important, but it is just as necessary that both Officers and non-commissioned officers should possess a clear idea of the science of fighting, and exhibit valour in the different circumstances that present themselves.

The leaders must endeavour not to let their men get out of hand, and must regulate the fire, judge the distances, and estimate the order and strength of the enemy.

All leaders, from Captains downwards, must observe that after carrying out a duty, their first business is to join the battalion rapidly, and their superiors must look to this for fear of troops getting out of hand.

A battalion is well commanded when the Captains, after a short order, combine to achieve a common end without the loss of the unity of command even for an instant.

Our infantry is able to repel with its direct fire even the most persistent enemy, and that enemy's losses will be so heavy, that the same troop can hardly make a second attack. This conviction should be impressed on the infantry, that it is unapproachable in front, and need only be anxious when it turns its rear.

An infantry which has its flanks protected and does not mind long-range fire, and opposes to the enemy's rushes its cool volleys, is invincible.

Therefore the covering of the flanks is most important, and the greater the distance of the supports, the greater the importance of assured flanks.

At the instruction of infantry, all the drill will be practised on the parade ground exactly as if the troops were before the enemy.

The application of the proper forms of attack and posting of troops must be taught on the actual manœuvre ground.

Upon the parade ground only certain things can be taught:—

Skill in executing the forms of attack and evolutions.

Intelligence as to the mutual relations between the troops and others, either on the flanks, or in front or rear.

Exertion.

Discipline.

It is, however, not necessary to practise numerous and complicated formations as valuable manœuvres.

A few simple forms, as given in the preceding pages, suffice for all purposes of field service.

It is, however, absolutely necessary that each battalion should be

able to execute with accuracy and without confusion the simple formation which service requires, on unfavourable ground, in darkness, rear rank in front, and even when unformed.

And upon this, beyond all else, great stress is to be laid—

That the influence of the Officer commanding, on the troops and the attention of the troops to the orders of the Officer commanding, and to the preservation of tactical connection, should not diminish either by the fatigue consequent on great exertion or by the privations of war.

Turning for a few moments before we leave the subject of drill to the French Drill Book,¹ I am glad to say that we find the same general principles re-affirmed and constant. I will quote two or three passages to prove this:—

To ensure cohesion and unity of aim, extended order should only be formed when indispensable, and returned from as soon as circumstances allow it.

The Officer forming the battalion must regulate the action and keep the power of direction.

The course of instruction in peace-time is laid down.

Transmission of intelligence is prescribed.

Whatever manœuvre is being executed, that the men should be everywhere and always well in hand: and therefore no difference must be made in matter of discipline, between formations in extended order and other ones. Each must give to his leader his sustained attention.

French attack formation is in—

Four Echelons.	
Skirmishers	} 2 Companies or ½ Battalion.
Reinforcements	
Supports	
Reserves ..	
	½ Battalion.

Depth from skirmishers to reserves about 600 yards.

The line attack is covered by scouts advancing to about 800 yards from the enemy's line of defence, and then deploys in rear of scouts who open fire within effective range. At 600 yards the line of attack joins the scouting line, and if reinforcements are required, they should be brought up, as organized fractions to avoid mixing sub-units. Supports conform to the movements of their own line, gradually closing up, and when required reinforce it. When supports are all in action, a company of reserves replaces them, and this is the time for final attack with the latter. If possible, save the last company as a closed body, but if not, send to second line for fresh battalion, and on first occasion reform battalion.

I will read as a last extract a paragraph respecting a battalion acting independently, in which the French Drill Book properly states that it is difficult to give fixed instructions, adding "if the officer commanding the battalion has during peace time instructed and exercised his units of combat in such a manner as to prepare them for

¹ "Les manœuvres de l'Infanterie." Edition 1876. Combat du Bataillon encadré. Par. 100 *et seq.*

“all eventualities, if he have himself acquired the skill to command and direct them upon the field of battle, in such a manner that each one of them, while operating under its own initiative in matters of detail and of execution of movement, yet conforms to its general instructions and acts for the common end, he will be able in many cases to apply to the original formation and to its duties in the action, the modifications necessitated by the alteration of circumstances.”

It appears then that the principles of French and German drill are the same, and when I add that the French, who had a six-company formation in 1876, altered it to a four-company one, like the Germans, we may say that those two nations have decided that the system of attack which offers the best chance of success is one in which the fighting unit is about 250 strong, and shall furnish its own skirmishers, supports, and reserves, and, in so doing, its sub-units shall not be mixed up; firing to be only by word of command; and that the system must be practised in peace-time. The same conclusion has been come to pretty generally through Europe. If we consider the above principles, we shall see that they only combine to secure power of direction.

A battalion in the field in attack-formation covers a parallelogram about 320 yards in front, and 500 yards in depth, and men distributed over this space can only be directed by one man, from the rear, on two conditions: he must have a command of depth from rear to front; secondly, there must be a command of front in the first line.

The space in the first line which can be efficiently controlled, may be stated at 80 yards by $\frac{1}{3}$ or $\frac{1}{4}$ of a company.

The command of depth can only be obtained by discipline, and no mixing of men.

And if we can find a system by which command of front and of depth by the Commanding Officer is attained, it will be a satisfactory one.

d. Let us now turn to our eight-company organization, and we shall find ourselves in this tactical difficulty, that we cannot get power of direction in depth and front; we must sacrifice either the one or the other—because the company of 100 men is too small. If each company furnishes, as on the Continental system, its own three lines, the skirmishing fourth or section will cover the company front, or about 40 yards. The second section will support the first, and the remaining half-company will form the reserve. In this way, the company will fight in column, and will satisfy the requirements of command of front and depth, by captains; but will have this disadvantage, that the first line will consist of eight small co-equal parts, and will lack the power of attack conferred by unity of aim, which even a field Officer in rear of, and commanding the line, could not impart to it. Colonel Home criticises this formation, showing that there will be no cohesion or unity of aim in the line of skirmishers or in that of supports.

He considers the area of command, 40 yards in front, and 200 or 300 in depth, too great for one Captain, and declares himself in favour of larger sub-units, and looks upon the mixing of men as inevitable.

But if too great for the Captain, how shall the Colonel command his battalion? and if too great for Captain or Colonel, what will happen to the battalion?

The powers of command must be acquired somehow.

But what prospect would there be of an attack so formed, preserving its unity of direction.

Formed in the attack order, 1,000, and possibly 2,000 yards off (for we read in the "Militär Wochenblatt," that the Turkish breech-loaders at Loftcha and Plevna caused heavy losses at even 2,000 paces), I ask what chance would there be that eight little sections of 20 or 25 files would advance, for, say, 1,500 yards to the attack of a position, over strange ground, some wooded and some open, without losing their direction, crossing each other's line, masking each other's fire; I say, what chance would there be of an advance so made, being successful, and what Commanding Officer could keep an efficient control over these little parties? I think, therefore, that we may decide that our companies are not strong enough to furnish their own complete attack.

Again, if to increase the unity of aim over the first line, we halve the number of units by doubling their strength and cover the front of two companies with a half company, and support with the other half; when the reserves of a different company come up to reinforce, the men become mixed; they lose the Officers, and the Officers the men; they are no longer under command, the power of control vanishes; and of course all these evils are aggravated by covering a half-battalion with one company extended. On reinforcement by supporting company, there is mixing, and by the reserve, treble mixing.

Therefore, it is difficult to apply sound principles to a small unit.

With regard to our own form of attack, it will not be necessary to say much. It has both advantages and disadvantages.

Two companies cover the battalion front, each under a Captain; and the whole first line under a Major, and an attack made with such a disposition ought, at all events, to have unity of aim.

Also, as No. 2 supports No. 1, and No. 4 No. 3, it is probable that the men will know each other more or less, and therefore facility of command will be increased.

As against the formation it may be said:—

- (1) That 150 yards is too long a line for effective control under fire, and the line of attack will get out of hand.
- (2) That the extension of the whole company, necessitates the support belonging to another company, which, though it be No. 2, is yet an evil, and causes difficulty of command.
- (3) That the difficulty is increased *à fortiori* when the reserves come into line.
- (4) That if the reserves do come into line, you have the companies hopelessly mixed, for on the one half-battalion front you have Nos. 1, 2, 5, and 6, and on the left you find 3, 4, 7, and 8.

The intention of this form of attack has clearly been to keep a complete half-battalion for the reserve; and this will be right or wrong, according to the use to which the reserve is put.

But the first point is to fix our unit.

Gentlemen, what is our unit now? Is it the battalion, half-battalion, or the company?

1. If it be the battalion, then we have a clear right to demand a smaller one, on the ground that one man can do now what four could do with muzzle-loaders; and it is, therefore, a waste of power to keep our battalion unit, and looking to the difference of tactics and arms, it is hardly likely that the organization of 1778 can suit 1878.

2. I do not think the half-battalion is our unit. It never has been either an administrative or a tactical one. The Major has no powers of punishment, and it has not been used in the field independently—as a rule.

3. Is the company our unit? It is and it is not. In the sense of being complete under one leader, it may be called an administrative unit, and it is detached at home and on service; but, in a tactical sense, it is not complete, *i.e.*, it is not independent of the battalion. It cannot be detached, for say 3 days; and I say, therefore, that the company is not our unit. If a German company is detached, it is complete in its organization, Officers, non-commissioned officers, and men, with its own company waggons, which hold the baggage of Officers, a reserve of boots, coats, other equipment, and 2,880 rounds of ammunition, *i.e.*, 17 rounds per man.

If we have a unit at all, it is the one that we have had for the last 100 years, from the days of Brown Bess.

That unit is the battalion, which was, and is, the administrative unit, which was the tactical unit, and is allowed to remain so, under a different armament, because it lends itself, with tolerable facility, to sub-division into smaller sub-units, which we call companies.

But, gentlemen, the smaller sub-units will not and cannot play the part of an organized tactical unit. It is not sufficient to say, if one company is too weak, send two; if two are too weak, send half a battalion. For fighting the breech-loader, you must have unity, moral as well as physical, at home as well as abroad.

Two horses will not necessarily make a pair, or eleven cricketers a cricket eleven; and for such unity as is now required, the men, non-commissioned officers, and Officers must know each other, must look, if possible, to only one leader, for their pleasures, their toil, and their subsistence, and live and work together in their separate relations during peace, if they are to have their full fighting value in war-time.

Such a unit is what a small army like ours most requires, one that shall put the men into action on the best terms, and compensate for numerical deficiency by superior excellence; and if we are agreed upon the following three propositions, *viz.*, that

breechloading arms have caused independent fighting;

difficulty of control is thereby increased;

difficulty is at a minimum when the command of depth and the command of front is assured;

we must inevitably come to the conclusion that this power of direction can only be obtained in one way, *viz.*, by having the largest unit that can be commanded effectively in extended order, and that is a unit of 200 or 250 men.

The Austrians have, in their re-organization, made such a point of obtaining control, by giving to each sub-unit its own leader, that

their company can be broken up into 4 sections, and each section into 4 small groups of 15 to 20 men, and yet supply each with a leader and a guide for front and rear ranks.

Thus, their company consists of—

1 Captain, 3 Lieutenants, 1 Cadet ;

1 Sergeant-Major, 4 Section Sergeants, 12 Corporals, and 18 Lance-Corporals ;

And can be sub-divided into 16 independent parts.

Similarly in the Italian Service.

We are told that in Germany the division of the battalion into four companies resulted from its being an economical organization. If it be so, it is not necessarily a reason for looking with disfavour upon it.

That in Austria and Italy the same system has been adopted because in those countries Officers were difficult to get ; while by universal service, good non-commissioned officers were plentiful.

But I cannot believe that all these great military nations in Europe have adopted (including France) an unsound organization for such reasons.

We have plenty of Officers and plenty of money. Our case is very simple.

Having a battalion unit in the service, we arm it with a weapon which multiplies its power and efficiency by 4. The weapon in the enemy's hands increases the difficulty of command in the same ratio ; and we reject the solution—

That the division of the unit into four companies will afford the best chance of meeting the difficulties into which the introduction of the breech-loader has brought us.

This I call a tactical deduction.

I venture to submit, however, for consideration whether there are not, in our present attack-formation, blots of principle as well as of detail.

Those of detail can be remedied at any time : but the blot of principle is, as I think, more dangerous.

It lies in the part which covertly as well as openly we assign to our reserves of battalion.

There is an underlying feeling that the reserves of a battalion of the first line are to be used for the *final* rush, which finds expression in Colonel Home's "Précis of Modern Tactics," in which it is stated : "The duty of the main body is to advance the moment the enemy is sufficiently shaken, and drive him out of his position ;" and even in our Field Exercise, page 211 :

"The duty of the battalion main body is, in conjunction with the companies extended in its front, to *finally* force the enemy's position." And again, page 223 : "The order to reinforce with the main body will be given by the Commanding Officer alone, and would probably *only* be necessary when the fighting line cannot push within 100 or 150 yards of the enemy."

Such an instruction, especially when a system of attack is based upon or even affected by it, I think contains the elements of danger, because it may and probably will indispose Commanding Officers

to extend the battalion main body for fear that if once thrown into the fighting line it will not be available to drive the enemy out of his position; and the result of such tactics will be long, halting, indecisive actions, which will give the enemy time to bring up troops to the threatened part of his position, and make his ejection an impossibility.

c. What are the lessons of 1870 and 1877? Why, that direct attacks hardly ever succeed, except at a most tremendous sacrifice. And in my opinion the suggestion that the four companies of a battalion are likely to "shake an enemy," may be a good one to instil into the troops of the first line, but it is not a proper axiom in military instruction.

Consider the circumstances under which attacks are made, how they vary. At Weissenburg five battalions attacked two French battalions on the Geisberg. The attack was made by half the force on half the front, the other half being in reserve, and the attack failed though they had four men per yard on the ground.

At Columbeiy, to the east of Metz, the advance brigade of the 7th Prussian Corps attacked the enemy's 3rd Corps, in order to delay its retreat over the Moselle. Before General Goltz, commanding the brigade, was supported, he had committed to the action 27 companies out of the 28 belonging to him. Subsequently he was reinforced, the French retired, and it was discovered that his attack had arrested two corps of the enemy on the right bank of the river.

Similarly, to the west of Metz, all chance of throwing back the Imperial Army into Metz depended on their being cut from the line of retreat to Verdun.

The 3rd and 10th Corps crossed the Moselle, and by means of forced marches, struck the high road at Mars-la-Tour, occupied it, and regardless of numbers attacked the whole French Army, which was then outflanking the German left. As everything depended upon maintaining their position, the 38th Brigade under von Wedell was ordered to attack some heights in its front, and the 16th and 57th Regiments formed for the attack, and on arrival found Grenier's division formed up to receive them with Cissey's coming up to reinforce, and the brigade could only re-form its ranks seven or eight miles in rear at Thionville.

Or again, if turning to the war of 1877, what was the loss of life at Plevna, when Skobeleff attacked the Green Hills to the south-west of Plevna and lost 8,000 men (it was said) out of 12,000, and stood in the centre of the attack piling one battalion on top of another! Gentlemen, I say we do not realize what these attacks cost, nor the endless variety of circumstances under which they may be made.

We are all ready to subscribe to the tactical formula that we must have five men per yard to attack a position; and then we talk of *shaking* the enemy with an expenditure of one or two men per yard. The attack is more serious than this, and in 99 cases out of 100 the reserves of the battalion of the 1st line, as well as those of the 2nd line will be pretty well expended before the enemy is shaken, and the time has come for the final rush.

As I read the military history of the last campaigns, the part that reserves have to play, is quite different. It is that of carrying forward the wave of attack, and not of making a final rush in line, though the latter was the duty of reserves when attacking muzzle-loaders.

Unless the defence is very weak, I do not think it probable and hardly possible that one battalion should be able to attain the enemy's position, and if I am correct, we should frame our attack formation to meet the difficulties of battalions expended in the fight and not those of battalions who can keep their one half in the ranks.

It is doubtless most distinctly the duty of Officers commanding battalions to husband their reserves, and to send them into action as sparingly as possible; and they must command a view of the attack, and feel the pulse of its strength or weakness so as to know when to send in their reserves, but they must realise that their highest duty is to forward the wave of advance, and possibly to exhaust their battalion in so doing. I believe that this is an accepted idea.

The real obstacle to the adoption of a good formation is that Commanding Officers cannot bear to realise that in the service of war their commands may melt away out of their power.

The battalion, and brigade, and Commanding Officers cannot bear the idea of being left without a reserve to forward an advance, or make safe the retreat, and therefore they will not initiate what I must call, for want of a better term, a single-minded formation of attack. But I can only say, that in my opinion this is the one lesson, the one fact which is proved to be the direct and inevitable consequence of the introduction of the breech-loader—that the fighting attack must be made *solely* with a view of attaining the enemy's position; that such troops as take part in it must be left out of the calculation of the available force for the rest of that day; and that the same thing will happen to us that has happened to Continental nations in these three last campaigns, viz., that Commanding Officers of battalions and regiments have been compelled to attach themselves to companies in the first line, because their commands had melted away from them in the exigencies of the fight, and they could not remain without joining something.

Gentlemen, I hope I am wrong, but I much fear that if we have not now profited by the experience of the late wars, we shall not do so until we have had our lesson.

The Austrians learnt theirs at Königgratz;

The Germans at Spicheren, Gravelotte, the combat of Flavigny;

The French at Sedan, and in the sorties from Paris; and

The Russians at Plevna and Batoum.

And all have realised that the part played by the old skirmishing line and the rest of the battalion, is now played by the battalion forming the attack and the rest of the brigade; and appreciating at once the difficulty of retaining command of the troops so spent, have reorganized their several armies to meet this result.

f. The remedy can only be ascertained by a consideration of the principles that influence and affect a fighting formation.

The problem is to attack or defend a certain front. Under old con-

ditions, say those of muzzle-loaders, it was found that a two-deep formation, preceded or not by skirmishing line, gave sufficient power to accomplish the required end.

Another arm is introduced, which fires four times as fast, four times as far, and thereby increases the efficiency of the individual enormously, and makes closed formations impossible within range.

The only solution is to be found by enlarging the principles of drill.

The difficulty of attacking depends on the relation between the front of attack and the effective range of the rifle. When each was 250 yards, a line of infantry sufficed. Now that the range is three times the front, you must reduce your fighting units and prolong your line of attack, and this is no doubt the origin of the system of out-flanking tactics now in fashion.

I take a company 200 strong to be the best sized fighting unit; small enough to be able to take advantage of cover, with as large a front as can be effectively commanded under fire, and strong enough to make a good attack or defence.

The German company is one-fourth stronger, and is formed into three divisions, of which one is composed of skirmishers.

These men are specially selected for this duty, accustomed to work together, active and skilled in the use of the rifle.

But in view of the great development of skirmishing, it seems to me better that every man should be practised in it.

Another distinctive characteristic of the German army is the perseverance with which they study the art of fighting. Any one who wishes to know how an infantry Captain instructs his men, can read Hauptman von Arnim's Journal, translated by Major East.¹

The advantage of learning the moves of a game before you play, needs no exposition; but I am satisfied that, improve our men as we may, and study the game as we will, we shall fight under more favourable circumstances against modern firearms, when we have a fighting unit that can find its own skirmishers, supports, reserves, and leaders who can be trusted to work with unity of aim.

And when we have attained so much of improvement as relates to the supply of ammunition, a perfect unit, and good leaders, there will be one more step to be taken before the machine is perfect, and that is, the cultivation of the intelligence of the rank and file of the Army.

We teach men to drill, to shoot, gymnastics, and, in short, cultivate them physically in every way; let us also cultivate them mentally, and make them practise in peace, that which they must perform in war-time.

Teach the soldier to think; teach him to obey an order in the spirit as well as in the letter, and in all that concerns the soldier only, such as dressing, covering, &c., and the more important duties on service, let him feel that it is his business to act as his commanding officer would wish him to act.

And when we have taught men to know the part that each plays in the great drama of war, and to feel the immense importance that each

¹ See Journal of the Institution, Vol. xxi, No. 89, page 275 *et seq.*

is, as one of the factors without which the game cannot be well played, and the paramount necessity, not only of his keeping his own place in the scheme of organization, but of helping others to keep theirs; they will come to feel also that when the attack is shaken, or possibly repelled, and their company disorganized, that they can still play a great part, *if* the element of re-forming lies within themselves, and if they contribute their co-operation no less than their obedience to the orders of their leader; and if their thoughts as well as their actions are at the service of their superiors; we shall then have done more to ensure the success of our arms than by any other improvement whatever.

As Colonel Home observes, there is nothing that tends to raise the moral power of an army more than education; the consciousness of possessing superior knowledge adds greatly to the power of an army.

And, as Captain May says in the "Tactical Retrospect," an army that cannot venture to trust in the individual value of its soldiers so far as to let them fight in irregular formations, cannot reckon on the advantages to be derived from the operation of the breech-loader.

And with such a change in the British Army, a great deal of our stiffness and slowness of drill will disappear, as it must do before the breech-loader, as unnecessary. Boguslawski says in his last book—

"The education of a nation in general and its military education in particular, are the sources of the tactical efficiency of its army."

"A good and simple formation is indispensable, but even this is of no use whatever without education."

Does any one suppose that such manœuvres can take place under fire as a deployment into line, an advance in line, a wheel in column, or that mounted points, and battalion and company markers, will be able to carry out their duties? Or does any one suppose that a battalion of the first line, will take its colours with it into action? And if they do, does any one think the colours will return to camp?

If the colours are left in rear, they become an element of weakness inasmuch as they deprive the battalion of so much breech-loading fire as is reserved for their escort. If they are with the battalion, what is their place? An advance in line with the colours in centre will not get within 200 yards of the enemy in my opinion.

A battalion, if it have to deploy, must learn to do so rapidly and silently without points, and properly instructed, the companies in succession will come into the alignment and lie down, the flank men putting up their forearms or their rifles for the next company to dress by; and when they find that this is expected, the men will rise to their higher duties, and the formations will be just as good.

I do not undervalue drill as drill, but I value it more for its moral than its physical effect.

Drill teaches obedience, smartness, good behaviour, self-respect and discipline, and is the most important element in a soldier's education. It makes a man a better soldier while serving, and a better citizen afterwards, and therefore is worthy of all praise; and when we realise what qualities are required from soldiers in a campaign, our drill or peace education will be made to lead up to their acquisition, but we

must not confound peace-time with war-time, nor go into the field prepared only with barrack-yard manoeuvres, or we shall receive such a lesson as we shall not lightly forget, for I am certain of this, if of anything, that the days of deployments, and advances in line before an enemy, are as completely gone as are the days of Frederick the Great, when they were in their greatest perfection.

Gentlemen, one word more. It used to be said at the close of the Great War, that one Englishman was as good as three foreigners, and there is no reason to suppose that they are any better, or we any worse than in those days, and in a twelve-foot ring, or in a street row, or with Brown Bess for our arm, it would probably still be true.

But we must recollect that every improvement in the art of war, whether of armament or of organization, tends to diminish our advantages, and with 300 yards between them, and an equally good rifle in the hands of each, one man is as good as another, that in short under the fire of the breech-loader, morale is in danger of losing its power because it cannot arrive *aux prises* with its adversary.

And if this be true, let us be careful, lest in presuming too much upon the advantages that we have had in years long past, we refuse to entertain the idea of modifying our institutions when they require it, or delay the necessary changes until it is too late, and possibly dangerous to make them. The secret of security is preparedness; we have inherited a vast Empire, but with it the responsibility of its preservation in its entirety; and as a French historian, M. Martin, says, "Une nation qui veut maintenir sa position devant le monde doit être *prêt à faire face partout*."

The discussion was adjourned to Friday, May 10th.

Friday, May 10th, 1878.

LIEUT.-GENERAL SIR GARNET J. WOLSELEY, K.C.B., G.C.M.G.,
&c., &c., in the Chair.

ON THE INFLUENCE OF BREECH-LOADING ARMS ON
TACTICS, AND ON THE SUPPLY OF AMMUNITION IN
THE FIELD. PART II.

By Colonel EDWARD CLIVE, Grenadier Guards.

In the last lecture I endeavoured to lay before you some of the difficulties into which the breech-loader has brought us; such as the supply of ammunition and the altered character of the fighting which formerly was in closed order and collective, and now must be in open order and individual, and I made quotations from the works of von Boguslawski, von Scherff, and Captain May, to show that this had resulted from the introduction of the breech-loader.

I propose to-day to consider:—

- (1.) The question of supplying ammunition, &c.;
- (2.) The qualities in our troops that will be most in demand in the actions of the future.

Taking first the ammunition question, I have by the kindness of friends been able to obtain particulars of the different systems of some Continental armies, viz.: France, Germany, Austria, and Turkey, which I will lay before you, and although our troops have never met breech-loaders, I will explain our own system both as it now is, and as it has been in our two last small wars, in Ashantee and in the expedition of last February against the Jowakis.

Commencing then the question of supplying ammunition, we must consider:—

- (1.) The expenditure in action, ordinary and extraordinary.
- (2.) The system of distributing it from the waggons, carts, or pack animals, to the troops in action.

Expenditure of Ammunition in Action.

The average number of cartridges fired in action is usually not large; though some regiments or parts of regiments may occasionally fire away a great many.

Thus in the 1st Prussian Army, which attacked the west front of the Austrian position on the Bistritz River at 8.30 A.M., in July, 1866, and remained heavily engaged all day, the average expenditure was only 12 rounds per man, though in one regiment it rose to 72 rounds, and in the case of two companies to 80 rounds.

Again, in 1870, the second division of French Imperial Guards at Rezonville fired an average of 20 rounds.

The French Army of Metz expended only 25 rounds per man, and in the same campaign the 12th German Army Corps expended in the various battles from 6 to 15 rounds per man only.

And even these figures are in excess of the real ones, for in them is included the ammunition that is lost (though not fired) belonging to the killed and wounded, and dropped by the living.

I may add here the experience of a field day that took place before the Emperor of Germany two or three years back, to test the rapid firing of the infantry rifle.

The troops that took part in it were 6 battalions infantry, 5 squadrons cavalry, and 1 battery artillery.

Five of the infantry battalions were supplied with 40 rounds per man, and the other battalion with 60 rounds per man, and orders were given to keep up the heaviest possible fire; and as it was an experiment with all arms, there is no reason to suppose that the movements did not represent an ordinary service action, yet no man fired more than 45 rounds. Of course the excitement of battle was not present, but I should think the result arrived at was a true one.

It must, however, be borne in mind that in providing ammunition for troops, the estimate must not be the ordinary but the extraordinary expenditure in one day; and also for the possibility that troops might be engaged for several consecutive days without having an opportunity of completing their supply of ammunition.

The amount carried by the British soldier is 70 rounds: viz., 20 in each pouch, 20 in valise, and 10 in the ball bag; which, however, will carry 30 more rounds if necessary. The regimental transport is charged in addition with 30 rounds per man in ammunition carts called the Regimental Reserve of Ammunition. Another 40 or 30 is carried in Division Field Reserve, and the same number in Corps Field Reserve; and at the dépôt there are also from 300 to 800 rounds per man.

Turning now to the amount of ammunition carried by the principal European nations, I have embodied the information which has been supplied to me in a table for greater facility of comparison.

Ammunition.	British.	French.	German.	Austrian.	Russian.	Turks.
In possession of Troops..	70	74	80	84	60	70 to 150
Regimental Reserve	30	18	37	35	40	20
Divisional Reserve	40	..	..	30	40	
Army Corps Reserve	40	46				
Ammunition Column.....	..	..	73			
Grand Park Dépôt.....	..	32				
Base Dépôt	180	170	190	149	140	
	300	115				
	480	285				

			Lbs. oz.
Weight of 100 rounds	Martini-Henry.....		10 8
"	"	French.....	9 10
"	"	German.....	
"	"	Austrian.....	
"	"	Russian.....	8 3
"	"	Turkish.....	10 5

The English System.

The materials available for our enquiries consist of the *Soldiers' Pocket Book*, an able report on the subject by Captain J. T. Barrington, R.A., treating not only of small arms, but also of gun ammunition, and of the systems practised in the Ashantee campaign, and in this last expedition against the Jowakis, the particulars of which have been kindly furnished to me by Officers who took part in those wars.

In our service each battalion is provided, as laid down in the *Equipment Regulations* of this year, with three ammunition two-horse carts, the carts containing sixteen boxes of Martini-Henry ammunition, each box holding 600 rounds, or 9,600 rounds. Total per battalion three carts = 28,800 rounds, or 30 rounds per man for 960 men.

The cart empty weighs	8 cwt., 2 qrs., 0 lbs.
Sixteen boxes "	1 " 3 " 20 "
9,600 rounds "	9 " 2 " 8 "

Total weight..... 20 " 0 " 0 "

The box produced is a service ammunition box, made of mahogany, with a sliding wedge-shaped lid, which is screwed down, so it is difficult to get at the ammunition. For the distribution twenty-two canvas bags are provided, viz.:

Two per cart for three carts.

Two per company for eight companies.

The carts have a leather pocket outside in which the necessary tools are carried, and the bags can be placed in a shallow well under the cart.

If pack animals are used instead of carts, twenty-four or twenty-five animals will be required for the service of reserve ammunition per battalion, inasmuch as one animal can only carry two boxes, which, with pack saddle and cover straps, &c., would weigh 206 lbs., or nearly 15 stone, exclusive of forage, picketing gear, blankets, and grooming necessities.

In the Ashantee campaign, where wheeled transport was out of the question, each infantry soldier carried his 70 rounds. The regimental reserve of 30 rounds was carried by coolies, each man carrying one box on his head, the bearers being under a non-commissioned officer.

The first reserve of 40 or 30 rounds per man, carried by similar means, had its place in the column of route under an Artillery non-commissioned officer, as also the second reserve of the same amount.

In bush fighting the expenditure of ammunition is often very great, and in the advance, instances occurred in which individuals fired more

than 100, and even 120 cartridges away probably with little result; and, of course, the difficulties of distribution and completion of supply were increased. As the boxes take some time to open, it was found advisable to have those in the first reserve unscrewed, and in that state delivered to the bearers of the regimental reserve, who returned for more ammunition.

The expedition under General Ross against the Jowakis consisted of One battery.

Four guns, R.H.A.

One regiment, cavalry.

1,200 British infantry.

1,600 native infantry and some sappers.

The fighting in the Bori Valley was done by 1,000 native troops with 600 British troops in support, covered by the Royal Horse Artillery guns, Ammunition taken was 200 rounds per man, of which 40 rounds were carried personally and the rest upon camels as far as Fort Mackeson, each camel carrying six boxes = 3,600 rounds. At Fort Mackeson the camels were replaced by mules, carrying two boxes each, who remained with the reserve.

When advancing in attack formation the mules remained on the top of the hill, and twelve men of each company followed in rear of skirmishers, carrying, besides their own 40 rounds, leathern boxes called "cartouches," each containing 200 rounds. The men disliked this work extremely, and it was found necessary to relieve them after two miles of heavy and broken country. There was little firing, and the system was not well tested.

Any troops in action can draw on a reserve waggon of first reserve for ammunition. It is not essential to give a signed requisition, but a slip of paper can generally be written and signed while the ammunition is being given out, which acts as a double check afterwards both on the amount of ammunition remaining in the reserve, and upon the corps who may have fired too much away.

The French System.

In France ammunition is divided into two categories.

That which is carried either by the men or in the battalion caissons, for which Officers commanding corps are responsible; and that carried and horsed by divisional artillery, for which the O.C.R.A. is responsible.

Battalion reserve is carried in four-horse waggons, one per battalion, regimentally driven.

Cartridges are carried in the ammunition boxes enclosed in canvas bundles fitted with a handle (each bundle holds 28 packets of cartridges = 168 rounds); one box holds 38 bundles or 6,048 cartridges, with 12 canvas bags for conveyance and distribution to the troops.

Each waggon has three boxes, or 18,144 cartridges. Requisitions on the regimental reserve are made by Captains, on the divisional reserve by the Officers commanding regiments.

The system of carriage and distribution is under consideration.

At present the troops in action send for it. The men sent fetch a bag with 60 packets, and distribute it; weight of 60 packets, or 360

rounds, about 35 lbs. But experiments are to be made on this subject at the forthcoming manoeuvres.

German System.

In Germany the regimental reserve is carried by regimental transport, 23 rounds per man, in special battalion six-horse waggons; and 14 rounds per man in the company pack carts.

The Jäger battalions have no battalion waggon, but an extra cart per company, making eight in all for the battalion.

Each waggon is provided with twelve canvas ammunition bags, each holding about 500 rounds.

Two or three men per company are told off for this duty.

Troop leaders can draw on the waggon under their orders for ammunition.

The Austro-Hungarian system for the supply of ammunition was reviewed in the *Revue Militaire* for 3rd November, 1877, No. 375, and two points come out strongly.

(1.) The issue of 12 supplementary rounds to troops ordered into action, making the personal supply 84 rounds.

(2.) The immediate and successive completion of the supply of ammunition at each halt, and even the completion of that of the supports when they go into action.

If the reserve ammunition waggons are not up, the drummers, buglers, and pioneers proceed to the waggons, fill up the bags with which the waggons are equipped, and which carry 500 rounds, and carry them to the companies, returning with the bags empty and repeating the process.

If the ammunition is to be delivered during the combat, the groups of reinforcement undertake the distribution to the men in the first line.

Lastly, any corps may demand ammunition from a reserve waggon even when belonging to another corps, and it is complied with.

No requisition or receipt is required, but an account is kept by the non-commissioned officer in charge of waggon, so that he may know the amount of ammunition yet remaining in charge.

Turkish System.

From a report made upon the Turkish supply of ammunition it appears that they used for its transport arabas, or two-wheeled carts, which accompanied the regiments on the march when they could do so.

For a difficult country, which was the ordinary state of things, or when going into action, pack animals were found indispensable.

Each battalion had from 24 to 30 of these, each carrying 2 zinc-lined boxes as they came from America, containing about 1,000 rounds each. The animals were led by men of the battalion, and on the cessation (even temporary) of the action the pack animals could be easily seen going down the line of skirmishers or entrenchments distributing ammunition.

The Russian cartridge weighs $\frac{4}{5}$ ths of the Turkish cartridge, and consequently they can carry a quarter more for the same weight, which is an advantage for transport when it is recollected that some Turkish battalions fired 150 rounds, or 16 lbs. weight, in one day.

This is probably the highest expenditure ever known; and it appears from the reports in the *Revue Militaire* and the *Militair-Wochenblatt*, that baskets for cartridges were found inside the Turkish entrenchments, and the defenders were thus able to keep up this *feu d'enfer*.

The Turks have no valises or bags to distribute ammunition.

The Turks carried little but food and ammunition; and in that manner managed to carry as much as 120 rounds, or nearly 13 lbs. weight of ammunition, which rendered them independent for several days.

Russian System.

The Russians in entering on the campaign conveyed their reserve ammunition on two-wheeled carts; they subsequently found it absolutely necessary to have recourse to pack animals. There are no bags for distribution. They have, however, the advantage with the new rifle of carrying only one nature of ammunition both for cavalry and infantry.

It appears then, so far as the quantity of ammunition is concerned, that all European armies either carry or have at hand a supply probably greatly in excess of their probable or even possible wants. The only question is whether our system of distribution is as good as that of supply. There are few subjects that will so well repay practice as the distribution of blank ammunition to troops in action; partly because the difficulties can be improvised as well for blank as for ball cartridge; and partly because there is nothing so fatal to the soldier in action as not having a sufficiency of ammunition.

I should like to see experiments tried for the elaboration of the best system. Serve troops out with 15 rounds, and make them fire 60. When the communication is perfect between the fighting line and the cart close to the main body, place it one mile to the rear, and try the system of communicating and the fire discipline of the men. Only take advantage of peace to anticipate and provide for the accidents of war.

In regard to the mode of conveying the ammunition, whether on wheels or on pack animals, it seems to be a question decided by common sense and the nature of the roads.

If the roads are good enough wheeled transport is a saving of horses, their attendants, their food, &c., inasmuch as a two-horse cart carries at least as much as eight pack animals.

If roads are bad, and carts cannot travel, as in the Jowaki expedition or among the Balkans, pack animals must be had recourse to. It would be therefore an advantage in equipping an expedition for service to supply some pack-saddles and horses with fittings, which could be used if necessary; and I understand that this will be done in our Service.

I am unwilling to close this subject without referring to the question of long-range fire which is exciting a considerable amount of attention on the Continent, and which has stout advocates and opponents.

The question for decision is, shall infantry fire up to the full range of the rifle, or reserve its fire?

The disputants on either side may be fairly personated by Major von Boguslawski and Captain Horsetzki. The former, who thinks long-range fire is full of danger, and should be absolutely forbidden, states:

(1.) That efficacy of fire is very questionable, because target practice is no real guide, and trying different ranges wastes the power of the rifle.

(2.) Heavy columns are less and less used on battle-fields.

(3.) It wastes the ammunition, and

(4.) It is opposed to the offensive spirit; and in a review in the *Réunion des Officiers* on the 1870 campaign, we read that at the Battle of Wörth "the long-range French fire had but a mediocre effect." And again, at Spicheren, "The fire of the division Lavean-confet at long ranges produces no appreciable effect."

On the other hand, Horsetzki is a strong advocate for it, asserting that the supply of ammunition is a matter of detail and organization, which must conform to the requirements of tactics.

The shooting is better at long ranges than short ones, but allowing that the fire must be at a fitting object, such as enemy's reserves; and adding, "for the defensive it is most important."

Ammunition can be supplied under cover; and the assailant must form his attack formation earlier, and troops will sooner get out of hand.

Thus von Boguslawski gives the following distances for effective fire:

When on the offensive—no firing till within 440 yards; or in a long hanging action, 600 yards.

When in pursuit, fire up to 770 yards; and against artillery, or columns, to 880 yards. When on defensive, fire to 770 yards.

Horsetzki says: Fire only by order. Marksmen to fire at large objects at 1,200 yards. All soldiers to fire at large objects at 1,000 yards. From 1,000 to 300 yards assailants fire by pelotons. From 1,000 to 800 yards defenders fire by pelotons. In truth the rights of this question cannot be solved by formula. They will vary with every factor. The power of the rifle; character and command of ground; discipline of the army, and even the state of the weather.

If troops on the defensive are under cover or entrenched, with plenty of ammunition, a good view of the ground in front, and skilled in the use of the rifle, it would be foolish not to use the powers of the arm up to their extreme range. And again, when troops are attacking, are in constant movement—changing the range every five minutes, unable to replace their ammunition—it would be foolish to waste rounds by shooting unsteadily at an ever-changing distance.

We may therefore sum up shortly by stating that long-range fire confers more advantages upon the defence than upon the offence.

I may here mention the results of some experiments made with the Werndl rifle in Austria.

A company, complete to war strength, was paraded and ordered to fire at screens representing a half battery of artillery at 1,400 metres, or 1,875 paces. 211 men of the company were armed with the rifle, and 10 shots per man fired; total, 2,110 shots.

On examining the target, after $3\frac{1}{2}$ minutes, 189 hits were found, or 9 per cent. of the shots fired; and all the men and horses were struck.

The battery then was made to advance to 900 metres, or 1,200 paces, and five rounds were fired, independently and in volleys, and at the end of the time the battery was out of action.

If soldiers can be trained to fire with such effect, it is evident that field artillery will receive a very sensible check, in its sphere of usefulness, on the battle-field; but, in any case, it must be confessed that the range and accuracy that rifles now possess have conferred a power upon infantry that was never suspected, and has not, by any means, reached its limit of development.

We will now take the breech-loaders in defence, and show what qualities are essential to troops to enable them to make the best use of the arm they carry. And, although my remarks will be, I believe, general in their application, we may, with advantage, consider them with reference to our own national wants; and I consider, therefore, the defence to be the defence of this country.

If, for the sake of argument, we consider the invasion of these shores as a fact, what troops have we for our defence? We must assume our Regular Army engaged elsewhere. A considerable part of our Militia, having volunteered to do garrison duty, with a view to relieving troops of the line, and this country left with the Household Cavalry and Infantry not sent to the field, a certain number of old and very young soldiers at Aldershot and at the various brigade depôts, the Yeomanry, some Militia regiments, and our Volunteers.

Colonel Fletcher told us, in his lecture on the "Disposition and "place of the Reserve in Time of War," that, by a calculation made, it was found that every twelve months' fighting required the replacement of 75 per cent. of the Service Army, to keep its numbers up to the war strength. And therefore, if we had 60,000 on service, we should require 45,000 more every year.

If this be true, it is idle to rely upon the enlisted soldiery for the defence of this country. The Reserve, by our hypothesis, is already in the ranks, and has therefore served its purpose. Of the Militia branch, the Reserve would be called up, and would take its share of duty, and many men would, doubtless, volunteer to join the Service Army, from the Militia and its Reserve.

There remain the Volunteers, 190,000 strong.

Putting the matter broadly, there appears to be no doubt that we should, for the defence of the country, have to rely mainly upon the Volunteers, and upon the drilled men who have passed through their ranks.

What would such a force, armed with breech-loaders, require to give it a reasonable chance of success against an equally good arm?

- (1.) Organization.
- (2.) Skill in the use of the rifle.
- (3.) Discipline.

I make no doubt whatever that organization is the first essential. We have a force, 200,000 strong, in the United Kingdom, of men in the prime of life, drilled and accustomed to wear uniform.

The Volunteers look upon their service in the light of a duty or time-tax due to their country, and it further appears that such service is grateful to them, and that, in almost all cases, they consider the portion of their year spent in uniform as part of their recreation, in so far that the duties and responsibilities of life are in no way prejudicially affected by their volunteer service. The country supports the movement and encourages the continually-increasing efficiency by certain money allowances to such Volunteers as satisfy a certain standard fixed upon by it.

But the laws that regulate enlistments for the Army are equally cogent for the Volunteers. And just as the bulk of our recruits comes from the centres of populations or from towns, so are the Volunteer Corps principally found in towns; and of the country corps, if we went into statistics, we should find the greater portion resident in towns.

From this fact, that Volunteers, as a rule, are dwellers in towns, we shall find there are advantages and disadvantages.

- (1.) It is easier for them to concentrate for drill.

- (2.) They are well educated and intelligent, and, therefore, they learn drill in a very short time.

And, on the other hand, their intelligence imbues them strongly with the desire for knowledge, and, impressed with a sense of their numbers and the gratuitous character of their service, they expect more appreciation and information than as soldiers they are likely to receive. But it is clear to my mind that the Commanding Officer of each corps which, or a part of which, would be approved for service, should be in possession of certain information, in the event of its services being required, *i.e.*, the part of the country which would form his head-quarters, the duties that his corps would have to undertake, whether garrison or field duties; and if a scheme of defence of this country were elaborated, which supplied such information, I think that much special knowledge of country roads, &c., would then be found amongst Volunteers which, in a time of invasion, would be invaluable, both for them and for their superiors.

We next come to skill in the use of the rifle. This speaks for itself; and, thanks to the Wimbledon Meeting, the efforts of the National Rifle and of other Associations in this country, rifle shooting has become most popular, and I should not think that any country in Europe has acquired so great a proficiency in rifle shooting as we have.

Lastly, I come to the question of discipline, without which individual fighting would be the ruin alike of our Army and our country.

In individual fighting, discipline is ten times more important than it ever was, and this must be not only understood but personally acquiesced in and conceded by every individual.

But, in considering the subject of discipline and instruction, we find that our Reserve forces are the exact converse of our regular Army. For whereas in the latter, from the circumstances of their enlistment, intelligence is rare, and it is found difficult to attain any high standard of military education, while, from their habits of life in barracks, they rapidly learn the principles of discipline; in the Reserve there is a high standard of intelligence, which renders the acquisition of the principles of military drill, &c., comparatively easy, while from their habits of civil life they learn the principles of discipline with difficulty. For this there is (in peace-time at all events) no remedy, except in the personal worth and character of each Volunteer, and in the high aim and ambition of the Volunteers generally to be in their generation, of service to their country as defenders of its soil. In short, they must agree with Boguslawski, who says in his last book: "Skill in individual fighting is the keystone of modern warfare."

"Increased self-reliance is essential. Skill in the use of the rifle necessitates an acquaintance with the elements of tactics in each individual; and lastly, a perfect physical training by means of gymnastics, and a mental training by means of instruction and education is requisite."

"All these qualities, however, must be controlled by the cement of a strict discipline, a compact connection in close formations, and strict obedience and inventiveness in those in open order."

Just consider for a moment what the vicissitudes of this last campaign have been. In my opinion, there has not for many years been any war in which, at so great an expenditure of blood, money, and at the price of so vast an amount of misery, so small a result, even in military science, is forthcoming.

The Russian Army, claiming to have an enormous superiority of numbers, poured down over the Pruth and Danube, was checked for months by a force of Turks who happened to occupy a position at Plevna, and who determined to keep it because their enemies were so determined to turn them out.

It was the Russians who taught the Turks the importance of Plevna; and I have little doubt that, if all the Turkish Generals had acted as honestly and as loyally to their country as did the men under their command, and had Suleiman Pasha thrown his forces either to the east to help Mehemet Ali on the Lom, or to the west to Osman Pasha, in the middle or end of September, that the Russians would be wintering in Roumania, instead of being at the gates of Constantinople. I merely instance this case of Plevna to show what may be accomplished by brave men in their own country, without transport organization, and indeed almost without the power of moving, if only they are well armed, have stout hearts, and, above all, have a national aptitude for fighting and for obedience.

Gentlemen, I have little more to say. I am deeply grateful to the Officers who have been good enough to come here to listen to my

remarks, and I only regret that I should not have been better able to do justice to the subject. I have brought it forward because I feel strongly that the military forces of this country belong to two categories—the Regulars and the Auxiliaries; that the Regulars are well disciplined, but, as compared with armies based on conscription, may be said to be relatively wanting in intelligence and education, and that the auxiliaries, on the other hand, are intelligent and educated, but want more discipline. The remedy, in each case, is in our own hands.

Lieutenant-General BEAUCHAMP WALKER, C.B.: I have read with very great attention the first part of Colonel Clive's lecture, and I wish to say a few words on the question of large or small companies, but I do so with great diffidence, because I have not devoted critical thought to the subject until quite recently. While I was in Germany my time was fully occupied in considering and reporting on what the large companies *did*. I found them and I studied them. I was not asked for any opinion as to whether the system of small companies was suited to the tactics of the day, or whether the large companies would fit into the English organization, and, although I reported very exhaustively on the general subject of infantry drill, I did no more as regards the general principles than the details of the unit. In fact, I reported on what I saw and what came under my observation without putting forward my own theories. I returned to England without having come to any very decided conclusion, and should probably have continued, I will not say indifferent, but passive in the matter, had it not been for a remark made to me one day while lunching at my club. My neighbour asked me for my opinion on the subject. After saying to him in reply very much what I have just said, I added, "But you know that I have given great attention to cavalry tactics, and I have no doubt 'on the subject of the squadron as the administrative and tactical unit.'" To this my neighbour at once replied, "Then on a like process of reasoning you must 'be an advocate of large companies.'" I said nothing at the time, but the conversation set me thinking, and I have formed a pretty decided conclusion. As an administrative unit I prefer the larger, also that the administrative and tactical unit should be identical. The Captain drills his own recruits, adjudicates on all minor cases of breach of discipline, and generally administers all the affairs of the company, thereby reducing the necessity for a large battalion staff in relieving the battalion commander from many small details, at the same time acquiring an authority over his men which cannot be otherwise than beneficial. In so far, the case of the large company and of the squadron are analogous. The large companies of that foreign army with which I have the most intimate acquaintance are commanded by a mounted Captain. Up to a very recent period the commencement of field manoeuvres was the signal for bringing up the Captains' horses from the rear of the battalion. I am very much mistaken if the day is not very near at hand when the commencement of manoeuvring under fire will be the signal for sending the Captains' horses to the rear, on the common sense ground that the mounted Captain is a certain mark for the enemy's fire, and that it is not desirable to have the leaders of your unit unnecessarily exposed. A Captain on foot can retain very little personal control over a company of 250 men. That the large units of the German infantry do get out of hand is an indisputable fact. No one laid more stress on this fact than the author of the "Tactical Retrospect." The limit of the tactical unit is, in my opinion, the limit of control. Now, a squadron leader is perfectly capable, by voice and gesture and trumpet (of the latter the less the better on the battle-field), of controlling and keeping in hand a squadron of cavalry; that is to say, he can make himself heard and seen by the leader of each of the sub-units. Indeed a squadron, well led, ought never to get out of the squadron-leader's hand until it is broken up in the *mêlée*. But the very extended nature of infantry drill now tends to the loosening of control. Twelve years ago, when the arms of precision were far inferior to those since introduced, when it was still customary for the Captains to remain mounted under fire, control was already a difficulty. The difficulty became more and more patent during the great campaign of 1870-1. I am firmly of opinion that

no prudent nation will from henceforth force the leaders of companies, nay, perhaps even battalions, mounted, into fire. It was never supposed that Captains could have controlled companies of 250 men unless they had been mounted; and, as I doubt the possibility of their being able to continue mounted amongst their dismounted men without the certainty of their being picked off at the very commencement of an engagement, I think that I am justified in assuming that the question of large or smaller companies is by no means definitively settled in favour of the larger companies. At any rate, I feel justified in asserting the proposition that the companies must be fixed at a strength which will admit the possibility of a sufficient control by their leader when fighting among them on foot. I certainly was under the impression that the losses in 1866 amongst the mounted Field Officers and Captains had been very much greater in proportion than that amongst the subalterns, and from a cursory examination of the lists of killed and wounded during the late campaign I formed the same conclusion, and was prepared to say that that was the case. My friend, Sir Lumley Graham, however, brought me the other day extracts from the actual lists of killed and wounded in the different ranks of the Prussian Army, and he assures me that the loss amongst the Captains was not so great as that amongst the subalterns, whilst the loss amongst the Field Officers was greatest of all. I hope, if he is present, he will mention the facts, because there is nothing like fair discussion of every subject.

Colonel Sir LUMLEY GRAHAM: As General Walker has stated, he was under the impression that the loss amongst the Captains and the Field Officers in the late war was in much larger proportion than the loss amongst the other Officers, and he was inclined to think that that was due to the Captains being mounted in action. Now, with all due deference to General Walker—he did not speak positively on the subject or I should not venture to question it—with all due deference to him, I think the Captains in the war of 1871 were not as a rule mounted, and I think the following statistics rather go to support that view. There are other persons in the room who saw a great deal of that war, and I think they can give us certain information on the subject. The German official account of the losses of their Army states that the deaths from all causes per 1,000 were amongst the Field Officers 105·18, Captains, horse and foot, 86·23, amongst the Lieutenants 88·69, and non-commissioned officers, rank and file, 48·01. Now we come to another table showing the deaths by violence, and that stands as follows:—Field Officers 96·29, Captains 78·99, Lieutenants 80·52, non-commissioned officers, rank and file, 31·17. Those tables seem to show that the Captains could not, as a rule, have been mounted in action, otherwise their loss would have been likely to have been larger than that of Field Officers, as they would be more exposed in the front lines of battle.

The CHAIRMAN: Were those Captains of all branches of the service?

Sir LUMLEY GRAHAM: Captains of horse and foot.

The CHAIRMAN: Including cavalry and artillery and the train, I suppose, too?

Sir LUMLEY GRAHAM: I presume so. We all know that the loss in infantry is in very much larger proportion than that of all the other arms. I wish now, with your permission, to say a few words on the general subject. I read with great interest Colonel Clive's lecture, but I will only speak on one branch, because the whole subject is much too comprehensive to be treated in ten minutes. One subject upon which I feel strongly is that of the company organization, and, like Colonel Clive, I am very much inclined to support the organization of battalions in few companies and large companies. I know a very large number of Officers of great experience take an opposite view, but the question seems to me to resolve itself into this:—We are all agreed that the company has become a more important tactical unit than the battalion, and, I think, we are all agreed that the stronger the company can be, as long as it can be controlled by an Officer on foot, the better. The battalion is now more an administrative unit and it is not convenient that it should exceed something like 1,000 strong. Given the maximum strength of a company that can be controlled by an Officer on foot and the strength of a battalion at 1,000, we have thus two known quantities in order to arrive at the number of companies in a battalion. The question lies between four strong companies of about 250, and eight companies of about 125 of all ranks. The German and all foreign Powers have adopted the larger strength, and they form the battalion into

four companies. We are about the only great nation that still sticks to the small company, and if we can convince ourselves that the large company can be controlled by the Officer on foot, I think we ought to be convinced of the superiority of the large company over the small one. That is the question we have to decide. No doubt, as General Walker has said, and as we have all read, the Germans found very great difficulty in controlling those large companies in action, but still they did manage and control them pretty well. If the Captains had not managed to control their companies they would not have succeeded in gaining those great victories. Wherever the German infantry met the French infantry there is no doubt the German infantry beat the French infantry on its own merits. It appears to me the way in which the Germans arrive at control over large companies is by very careful previous training, and by dividing the responsibility of command in the companies. We know that their divisions, and their half divisions, and sections, and their half sections each have a leader. This leader, in action and on the drill-ground, is responsible for his particular body. It is by the careful training of these sub-leaders that the German Captain manages to control the large company. That is shown in a very interesting paper written by Colonel Lonsdale Hale, a *précis* of a series of articles which have appeared in the *Revue Militaire de l'Etranger*, and this gives a most minute account of all the interior economy of the Prussian company, and of all the excessively careful training given by Prussian Captains to the subalterns and men. I dare say most of you have read it, those who have not will do well to do so, and you will find in that article the secret of how to control large companies. Of course, under our present system of Army Organization, our Captains could not control those large companies, because they have not the military education to enable them to do so, and the men would not be controlled—the non-commissioned officers and subalterns not being sufficiently trained. One of the strongest arguments to my mind in favour of the strong company is, that it enables you in peace-time to give so much higher training to Officers and men. With our small companies (at the lowest peace footing, some 60 rank and file,) you will see a company day after day showing three or four files on parade. For drill purposes two or three companies have to be put together, the Captain never gets an opportunity of having "company drill," or of giving "company instruction," and the consequence is, such a thing is at present almost unknown in our Army. That reduces the value of our companies very much. The effect of introducing the large company system would give an immense impulse to military efficiency, and that, to me, is about the strongest argument in favour of introducing the large company system. There is one thing to be said. At this moment things look threatening, there is a possibility of war, and I should think, even if there were an idea of adopting the four-company system, we should be very unwise in making such a change at this moment. These changes ought to be made immediately after a war. The Germans set us the example of that, they made all sorts of changes. Though they were so successful in their two last wars, they saw that there were improvements to be made and they set about those improvements at once. That is what we must do after our next war and not now if a war is approaching. The Russians did something of that sort just before the Crimean War, and they suffered from it. They adopted at that time the Prussian system of large companies and company columns; being new at it, it did not work well at the Alma, still less at Inkerman, they suffered very much from doing that, so that whatever changes we make, should be made after the war and not immediately before it. Allow me to say one word more with reference to what Colonel Clive mentioned, as to long range and short range firing. Colonel Clive did not, I think, mention that the Germans are much in favour of firing volleys at the long ranges, nor that they have lately been experimentalising on a system of firing such volleys, with sights adjusted to three different ranges, a portion of the firing party being told off to each range, thus covering a space of, say between 600 and 800 yards, and providing against any error in judging distance. That seems rather an important idea, and it is one which some of their Officers favour very much indeed.

Major-General Cox, C.B.: The subject for discussion this afternoon, may, I presume, be reduced to the simple question as to the proper strength of a company for the British Army, and the proper way to make use of such a company. The

influence of breech-loaders, of course, is very great over all branches of the Service, and affects other branches almost as much as it does the infantry, but in the present instance I will merely state what I think should be the strength of a company of infantry. It appears to me, that whatever may be best for other armies, the most suitable strength for a company of British infantry is one which would put about a hundred men in the field, on parade or in action. It will be necessary, of course, to have a good many more, and taking into consideration sick, non-combatants, and employed men of various descriptions, such as transport men—and the number of employed men, I fancy, is rather increasing than diminishing—taking these numbers into consideration, the company should probably have about 130 or 140 men, so that you can always put 100 men on parade or in the field. A Lieutenant-Colonel, with one Major, should very easily control eight of these companies, either in peace or war.

There are several objections which occur to me against our having companies of the strength of a German company, that is to say, from 200 to 250 or more, and these objections I will mention as briefly as I can. In the first place, I think a company of about 200 men is unwieldy, and more than one Captain can efficiently and properly control and command. In saying this, I think a Captain ought to do even more than he at present does to his company. He ought to be almost all in all to his company, and ought to be not only responsible, as at present, for their arms, accoutrements, and messing, but he ought to be their drill and musketry instructor, and their instructor in other branches of their profession. Of course he could not do this alone, but the Captain should be the responsible person, and the subalterns ought to be his assistant instructors in these respects. The Captain ought so far to have the company at his disposal, that he can take them out or educate them in any way he pleases, say once or twice a week. The person to be looked to for any fault in the company is the Captain of the company. If the drill is badly performed, it should be asked, why does not the Captain see that the men are properly drilled? and similarly if anything else goes wrong with the company.

In the second place, I think companies, such as the Germans or the French, are unsuitable to the requirements of the British Service, and in this way. We are frequently required to give small detachments; in parts of the United Kingdom, say Ireland (and in many of the Colonies), there are constantly occasions when one has to detach 100 men, or 60 men, or very much less, at all events, than 200. If you want to send a large detachment anywhere, it is very easy to send two companies, but it is not so easy and it breaks up the organization completely if you send half companies or quarter companies to different stations. Therefore, for this reason also, I think it better to have a company of about 100 or a little more than 100 men.

Another thing is this, the efficiency and destructiveness of the breech-loader increases the difficulty of control. Now, instead of increasing the difficulty of control, we ought rather to seek to diminish that difficulty, and, *primâ facie*, the means to do that would seem to be to reduce the number to be controlled and not increase that number. It constantly is necessary in the British Service to act with small detachments and small forces. We, more than any Army in the world, have to do with petty wars; we have to conduct bush fighting, such as is going on at present at the Cape. It seems to me in such warfare as that, it is just as much as one Captain can do, with the ordinary staff of Officers and non-commissioned officers, to efficiently control 100 men in action or in the bush.

The last reason I should give is one which I feel a great difficulty in bringing forward, as I know that the contrary opinion is held by many high authorities in foreign Armies, and also by very able Officers in our own, and that is a question of tactics. It seems to be universally conceded that all fighting, or almost all fighting, will be in open order—the greater part of every action, at all events, will be conducted in open order—this open order consisting of skirmishers, supports, and reserve. Now, although the proportions of these may differ slightly, we may assume the skirmishing or fighting line will be one-fourth of the force, the support another quarter, and the reserve the remaining half. Now, one reason assigned by the lecturer and others, for having very strong companies, is that each company should furnish its own supports, skirmishers, and reserve. From this I beg to differ slightly, as I do not think a company ought to furnish its own support and

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reserve, as well as its skirmishers. Supposing a company to be in skirmishing order, two sections or half the company being in reserve, the post of the Captain of the company would naturally be with the reserve; how then is a Captain on foot, whose means of control are limited to voice, whistle, or signal, to control his skirmishers and supports, especially when fighting or firing is going on, the skirmishers whom he would nominally control being, say, 500 yards away from him? It is perfectly impossible that he can do that. Then again, it may be said that a Captain should be mounted. Even supposing that he would exist for any time mounted with skirmishers, it seems to me that this would break our whole system of organization. If every Captain was mounted and was to command 250 men, there would be an outcry before a fortnight was over that all Captains should be made Majors, and very naturally so. I am sure I should join in it if I was a Captain. That appears to me to be a great difficulty in having skirmishers, supports, and reserve all from the same company; the Captain could not possibly control three lines together, because he would be at least 500 yards away from one or other part of the line. Then, though I see no objection, in fact, I think it would be a very desirable thing for the skirmishers and supports to be of the same company, I do not think the reserves ought to be. Skirmishers and supports may very well be of the same company, because I believe the duty of the supports to be simply to feed the fighting line, that is, that they should be under the control of the Captain of the company, who would send as many men as were necessary to fill up any gaps, or temporarily to strengthen any part of the line. He could send one man or a dozen men to any part to fill a small gap, therefore, I think skirmishers and supports may very well be under the control of the Captain of the company. On the other hand, I think the reserve should be immediately under the control of the Colonel of the battalion. The Colonel of the battalion being mounted, and being not more interested in one company than another, and seeing what is going on over the whole line, would, far better than any individual Captain, be able to say what part requires reinforcement. If it were otherwise, each Captain would naturally look to his own company, and he would think that they were most requiring reinforcement, and if he was at liberty he would send the reinforcement to them, so that when the Colonel wanted the reserve for any particular purpose he would find the Captain had sent them all into the fight, and that there was no reserve to fall back on. I think, therefore, the reserve should be under the exclusive control of the Colonel of the regiment. Another reason for that is this, that four small reserves, formed by the reserves of four different companies, would not be anything like so efficient as one strong reserve, or even two, supposing they were worked by half battalions. The Colonel is the Officer who sees where the decisive attack is to be made, and having the reserve under his control, he would be able to direct the whole of them together on that point at his own discretion, under orders of his superior Officer. As regards the line formed by the skirmishers, half a company, such as I have mentioned, would be about the proper length which could be easily controlled by one Officer—50 men would occupy about the space which one Officer could efficiently control.

Lieutenant-Colonel BLUNDELL, Grenadier Guards: I will not touch upon the lecture of to-day further than to say I think it would be a good thing if the pay-sergeant of a company had always a round of ammunition in his pouch for each man of his company, to prevent its being ever absolutely without ammunition. With reference to the former lecture, my excuse for troubling you is, I have taken great interest in this subject for some time, and wrote upon it in 1872, feeling as Colonel Clive has felt, that there was a necessity for a smaller "tactical unit" for infantry, a smaller "unit of force,"¹ as it is called; but also feeling, contrary to the opinion that he has arrived at, that that was not to be obtained by increasing the size of the company. With regard to the strength of the battalion, the weight of authority has always been in favour of small battalions. The Duke of Wellington said, if you have

¹ A technical expression, sometimes used by military writers to denote the body of men which, when manœuvring in close order, moves at the word of command of one Officer. In the British Service it has been the Lieutenant-Colonel's command, and called the "battalion."

twelve companies, make them into two battalions: they are "much more manageable" in manœuvre." Napoleon said the front of a battalion should be 130 yards, Frederick the Great, 120 yards. Every writer on the subject agrees it should be such a length as can be controlled by voice and gesture, and that any mistake in it can be rapidly corrected by its commander. Supposing we assume 130 yards as the front of a battalion as what a man can control by voice and gesture, we find that 400 men in close order approximates to that length. All the arguments that used to apply in favour of that length still hold with regard to the line of route, marching along a road or manœuvring in close order. The question of length depends upon physical conditions, and no change in arms can alter them. Our present "field exercise" may be termed a permissive act. It permits almost anything; it allows, and wisely, Officers to adapt their dispositions to the circumstances and to the ground, but it assumes that the Officer commanding what we term the battalion will command it directly by his own word of command in manœuvre, and up to the moment of entering upon the attack, the formation of which is completed at 2,000 yards from the enemy. I believe that if this discussion were to lead to a rule that on the column of route or in manœuvre, a Commanding Officer should move his command in half-battalions under the Major, if he has more than, say, 400 men, it would do immense good, because everybody must admit that it is possible to be attacked on the line of route, and there is not an Officer who has been in a large long battalion of 800 men who has not felt that there was a certain tardiness in the movement. And in the present day it is almost more important to be able rapidly to assume whatever formation circumstances require than to have any stereotyped formation; therefore, I think that if it was ruled that a Lieutenant-Colonel should never command his whole command directly—that is, by his own word of command—if it is over 400 men, great good would result. But when it comes to the question of increasing the company, I differ entirely, and for many reasons. I contend that just as you find the limit of the line of a battalion in close order to depend upon the voice of an Officer and his power of control, that the same thing applies exactly to the front fighting line. I contend that a Captain cannot command more than a line of 130 yards; that he can only command the men with whom he is. A Captain should be *with* his men. I cannot believe in a Captain who is not with his men. If he is 500 or 600 yards¹ in the rear he cannot control them. He may be a Captain in the general sense that all military leaders are captains, but not in the true acceptance of the word. Many people who go in for the large company contend that there is great advantage in the support and reserve coming from the same company, as it is called. I will read you a few lines from the "Tactical Retrospect" on that point. It is a treatise that has been much spoken of:

"In this striving of the supports and reserves to force themselves forward into the fighting line lies the impossibility of preserving the old-fashioned order of battle, or even the primitive tactical formation.

"Every division in the rear which has hitherto remained in close column rushes in where necessity or a possibility shows itself. An interchange between the engaged line and its supports is evidently impossible; there is not even the smallest guarantee that a company will fight together with the skirmishers which it has itself thrown out, or that the companies of a battalion, or the battalions of a regiment will ever come together. Let any one compare the state of every single battle of 1866, with regard to the positions of every division of the army after the troops had been well engaged, and the old-fashioned order of battle."

Therefore I maintain its front fighting line should be the smallest complete integral fraction of the regiment. If it becomes separated, there it is, a complete military body. It has a name; you can speak to it—A company, B company, or whatever it may be. It will not do to say "the right or the left squad or subdivision" of such and such a company. I contend, therefore, that it should not exceed what would produce, say, forty files in fighting formation, which would be, at our interval of

¹ Let those who think that a Captain can control his company of 250 men through a depth of 500 yards read Chapter IV, von Boguslawski, on the conduct of infantry in battle, particularly pages 77 and 80.

3½ yards, about 130 yards.¹ There is a great difficulty in any military discussion, the same one that I believe is found in all clerical discussions—terms are so confusing. For instance, we say the Lieutenant-Colonel commands a battalion. Now, every battalion in our service, except in the Guards, is a regiment, just as much as a Lieutenant-Colonel's command in cavalry is a regiment, and tactically a battalion of Guards is so too. That is to say, no regimental authority on parade is superior to its Lieutenant-Colonel. If it was called a regiment, I believe things would be much simplified.² People attribute to the Prussian company as a merit, its being a company, whereas I submit that to be its defect, and that its merit was that it *acted as a small battalion*. Many people look upon the large company as a modern invention, like the needle-gun, instead of a thing that came down from long ago, which was seized upon with the promptitude of genius by Moltke as furnishing what he then wanted, *small columns*. I will read to you what he says about it. He had been discussing the English advance at the Alma, and the great difficulty of advancing in line with any length of front, and he says:—"From these experiences we infer now as heretofore the column formation affords the best means of handling troops, both in an attack and in an actual fight. Although the fire of artillery at long ranges forces a column into an early deployment, yet it does not prevent the approach of a line of columns so small as to be able frequently to obtain cover from the inequalities of the ground, and to advance with great rapidity. . . . The system of company columns . . . is adapted to meet all these contingencies."—"Observations on the Influence that Arms of Precision have on Modern Tactics." By Field-Marshal Baron von Moltke. July, 1865. Translated by Lieut. H. R. Crawford, R.A.)

Therefore it was not its being a company, but its forming a small column which could advance with great rapidity that commended the Prussian company to Moltke. The Prussian company, I am bound to say, I believe in matter of size to be a very perfect military body. In the English Service 32 files has always been considered the very best size for what we term a company. Supposing 4 companies of 32 files formed into a small battalion, under a Major, you would have the same number of men as you have in the Prussian company within a few. There would be one company in the front attacking line, one of equal size in support, and two in the rear as the reserve. That would form a perfect part in the regular attack of a line of battle, and I believe would be found excellent; and if for the moment we used our half-battalion, that it would supply us very nearly with that,³ and that in our present drill the only thing that would be necessary would be to bring both half-battalions alongside each other, and attack precisely according to the drill-book.⁴ Having said I believe with the large company the Captain cannot command it tactically, because he cannot exercise control over 500 yards of ground in depth, I say also he cannot command it in an administrative sense. In our companies the Captain knows the name, the face, the character of every man in his company, or at least many do; they know whether a man is near-sighted, whether he is deaf, whether he is intelligent, whether he is quick. They know all that, and if they do not know it, the colour-sergeant does, so that this knowledge is at their disposal. I contend that this is an immense advantage. Some men have great aptitude in learning all this kind of

¹ This applies to the first action of a war. The cadre, it is to be feared, is never too full as war continues.

² It would then be possible to call what is now termed the half-battalion of four companies the battalion, which, led by a Major, would be the normal unit of force for infantry when regiments were at the war strength, and like the squadron in cavalry, would be intermediate between the Lieutenant-Colonel's and the Captain's commands, but would have, as Marmont wanted the squadron to have, a commander superior to the leaders of troops.

³ The system of voluntary enlistment in the British Service cannot be relied upon to fill up regiments as a compulsory system does. However, as long as the small company is retained, the Lieutenant-Colonel can subdivide his command into such bodies as he thinks best.

⁴ The effect of this would be to keep each half-battalion separate as far as practicable.

information, and it is possible for a Captain in peace-time to learn it with regard to 250 men; but supposing him killed in action with the four-company system, it is three to one his successor comes out of another company. He cannot acquire all that knowledge which with a small company he would acquire, in some degree, in a fortnight or so. He would shrink at the task, and never attempt it. Therefore I contend most distinctly the company should not be more than a Captain can tactically supervise in the front attacking line, as it cannot count with certainty upon anything in rear joining it, and he cannot efficiently administer a larger command in time of war.

Major-General the Hon. PERCY FIELDING, C.B.: I was unfortunately detained at the Stafford House Committee, and so missed the commencement of this discussion, and fear lest the few remarks that I shall venture to offer may have been made already by some one else. I was, however, in time to hear Sir Lumley Graham, and I feel sure that we must all agree with him in one respect, viz., that whatever alterations it might be advisable to make as regards the strength of companies, this is not the time to make them. There is, however, another consideration which, in my humble opinion, is of much more importance than the actual size of a company, and that is the manner in which it is led. Ever since I joined the Army, thirty-two years ago, Captains of companies have been educated in the belief that their duties in the field were restricted to the carrying out such orders as they might receive from their superior Officers. What we want is to bring to bear the intelligence of the Officers, so as to make the most of the soldiers under their control and management, and I submit that the change in modern tactics renders it most essential that more scope should be allowed to Officers for the exercise of their judgment and intelligence than has hitherto been considered necessary or admissible. I have commanded a brigade at two or three of our autumn manoeuvres, and at the field days have almost invariably observed that not only the brigades, but the individual battalions composing them, generally got more or less out of hand, consequent on extension and mixing up, and that mistakes arose which would not have been made if Officers commanding companies did not feel themselves so tied down to wait for orders. Many of the mistakes I have seen made at manoeuvres and sham fights would doubtless not have occurred in real warfare, because not only the Officers, but the men under their command, seeing the enemy, would act more readily according to the dictates of their intelligence, but if we believe that such would be the case, I think that there is the more reason why the practice in peace manoeuvres should be that which we would wish it to be in actual warfare, especially as it must be far easier for a Commanding Officer to correct a mistake made by one of his Captains than to send definite orders to each of them individually when the battalion is in extended formation.

Lieutenant-Colonel C. B. BRACKENBURY, R.A.: In any case I should have very few words to say, and the last speaker has taken many of those words out of my mouth. I did not perceive in the lecture which has been read that the value of large companies was put forward as the only topic for discussion. There are many other topics in the lecture which appear to me of even greater interest and importance. It is evident, however, that this subject must be exercising the minds of everybody in the room, from the fact that everybody appears inclined to speak. However this may be, I think it would be very rash to take the subject up now, or to alter our battalions in any respect at present. There is an old saying of President Lincoln's that we should not "swap horses while crossing a stream," and we seem to have a very ugly stream in front of us just now, so perhaps it would be quite as well not to talk about swapping horses at present. Another very distinguished man—perhaps one of the finest soldiers at this moment in Europe—General Von Kuhn, lately the Austrian Minister for War, once asked me in Vienna what we were thinking about at that time in England; I told him the size of companies; he said, "That is the way, 'you are always looking on the ground; it does not matter what the size of your companies is; you must have thoroughly good Generals and intelligent Officers, 'intelligence distributed as far as possible throughout the Army, and then it matters 'little what is the size of your companies.'" As far as my own opinions are concerned though, as an artillery Officer, the subject is one on which I speak with diffidence, I happen to have been a great deal with infantry in actual war, and per-

haps you will allow me to state them. I believe a large company would be better as a tactical unit in case of continental fighting against a civilized enemy, but the small companies may possibly be better for bush fighting, and under these circumstances it is rather difficult to say which we English should choose. There is, in short, much to be said on both sides. The paragraph which strikes me as containing the whole gist of the lecture is this :—"The real obstacle to the adoption of the formation is "that Commanding Officers cannot bear to realize that in service their commands may "melt away out of their power." I should go as far as to say they MUST melt away out of their power. I do not think I ever saw a case of a battalion or a brigade remaining in action against an enemy without getting mixed up. Whether you have only small or large companies you cannot help that, and therefore the main point to urge the Army is that every Officer, be he Captain, subaltern, or of any other rank, should be ready to make the most of the few men who at that moment are ready to his hand. One of the points which troubles the Officers of the infantry is that, in time of peace, the number of men in their companies is so small that they themselves become more or less nonentities. They are unable to take their men out to drill them tactically, or to work them in any way. That is being met at Aldershot by a system of very small manoeuvres in which Captains are allowed to command men as well as their seniors, and the remedy for the complaint of the Captains may be met by a development of this practice. There is one very interesting point mentioned in to-day's lecture, but not yet noticed in discussion ; it is the power of long-range and short-range firing. So far as I have seen, the fire of the enemy is generally more dangerous at a considerable range than at a short range, provided he is not lying down behind a breastwork where he can rest the rifle and fire steadily. The men seldom aim when at close quarters ; they appear to be always anxious to have their bayonets ready to be down at the charge, and the consequence is that they scarcely ever put their rifles up to their shoulders. I have seen that both in the case of the French and the Turks. Whenever the Russians were close to the Turks, the Turks fired in that manner, whereas at a distance they fired steadily and with very fair aim. The effect of well-sustained long-range fire is very great. Such being the facts of the case, the steady supply of ammunition in the field is, to my mind, a more important element of success than the size of the company.

General Sir WILLIAM CODRINGTON : The explanation of Colonel Brackenbury's statement about the long-range firing is, no doubt, that soldiers generally will fire high, that is to say, they will not take care to aim. When the Russians reported that at the Battle of Inkerman they suffered such loss in their reserves from our far-reaching rifles, it did not arise from our seeing the reserves, at all events to aim at them, but from the quantity of fire and the high fire—you may say the incorrect fire—which passed over the heads of the front and fell among the reserves. It is a frequent fault and a bad habit of soldiers generally, and that opinion is confirmed by what Colonel Brackenbury has said with reference to the conduct of the Turks and of the French in their late wars. The main feature of present first attack, in consequence of breech-loaders, must be an open-order attack, as I should say, instead of calling them skirmishers ; that they are to be at open order and to be reinforced gradually up to what the line originally was, for the last and final rush. The difficulty is to get those men in that open order up to the formation of that more compact mass by which you must overcome the enemy who is also posted in a compact mass ; because my impression is that on no occasion have skirmishers at open order, say three paces, four paces, five paces, whatever it may be, ever successfully attacked a determined and well posted enemy in close order. Taking the usual question of the "*gros bataillons*," you must bring the men in equal or superior numbers to the point you want to take. Your skirmishers will not do that, therefore the object will be to get a combined open-order formation in the first instance, to get men to support that, and then when near the enemy, get your men into more compact formation within a short distance for the final rush. As to the size of the company, I remember when the Army was sent to the East we were in companies of 108 or 110—52 or 53 files, and that was quite as much even in common marching as any Captain could command with his voice. I should say that when you are once on service, what with sick, orderlies, and men otherwise employed, one-fourth of your company would be absent from it, and the remaining three-fourths will be all the bayonets you will get

to fight with. I therefore consider that the company of 100 or thereabouts is the company best for our service. Without going into detail of the attack, which seems to be a point on which there is great difference of opinion, it surely is a great object that the attacking portion of a company or the skirmishers, and the next open order support, and the final company reserve, should be under one similar command for administrative and military purposes, viz., by the Captain of the company. Therefore in the smaller company I think you get more direct command from your Officer and non-commissioned officers than if the company were extended over the whole front of the battalion, by which you must mix up companies when reinforcing for attack. This is the disadvantage in having the front line only formed of one company, that is to say, of the whole company. My own feeling would be to arrange that the company should have its own attacking open order, its next attacking open order, which should support the first line when necessary, and finally its reserve, which should also reinforce the attacking line or body that has to come *aux prises* with the enemy, trusting to other battalions for your reserve for another final rush or movement on a flank. That would be the business of the General, but my impression is that the company when it comes up to 100 is large enough. We must not judge by companies in peace at all. The companies in peace are sometimes about ten files, and give no practice of command.

With regard to infantry ammunition it is most essential that the supply in action should not depend upon wheel transports. We have now one cart in peace for blank cartridge, and it is, I believe, to be three in war for each battalion. In the first place we have not tried two horses with ball-cartridge ammunition for a cart, and I do not believe two horses would drag even the common ammunition cart now attached to a battalion up many of the deep sandy slopes of Aldershot with ball cartridge. If they did, they certainly would not do so very often. That weight of ammunition, viz., 16 boxes, would probably require four horses on service, and that becomes a serious business. I will now read the opinion of an Officer to whom I think credit will be given as authority, namely, the late Lord Hardinge. When I was in the Crimea, arrangements had to be made for the supply of ammunition for the future campaign; and although the Staff of the Crimea have been a little looked down upon as rather inferior, still a certain quantity of good service was done there from the beginning by the arrangements which were made. I am speaking now of an interval before I belonged to that Army. I remember seeing the great care taken by Officers of the Staff in that Army, the artillery particularly, to practise the landing of horses, guns, and supplies, and how the Staff helped in arranging every single detail. I remember also how the whole of the troops were sent on board in 100 to 120, or 130 ships that crossed the Black Sea, all of which required a very great deal of arrangement by the Staff. What did Lord Raglan do with regard to the supply of ammunition, for that is the point to which I am coming? The only *bât* animals that were taken across were 150 mules or horses for each division of the Army, for the purpose of carrying ball cartridge. They were landed and kept up with the Army as Lord Raglan had settled: they went on to the Alma, marching with the Army, crossing the Katcha and Belbec rivers, and so on to Balaklava. Afterwards, when the Army was increased, the artillery had proposed that the first reserve of ammunition for the infantry should be on wheels, horsed by the artillery, and in charge of artillery Officers; and a memorandum to this effect was sent to Lord Hardinge when this increase of the artillery and establishment was to take place. Lord Hardinge wrote,—and I quote it not as my own, but as the authority of Lord Hardinge, who certainly, from his experience in the Peninsula, and being Commander-in-Chief in England, of course wished everything to be done in the most perfect way for the Service:—"The first reserve of infantry ammunition is that of thirty rounds a man, carried on mule back, and marching with regiments, brigades, or divisions, and not with the artillery. The ammunition carried on the artillery waggons is the second reserve." Whether it be carried in rear of divisions or brigades, it is important that there should be means of moving it to the rear of a battalion on a pack animal of some sort, whether a mule or horse; and if the present preparation is really to be one for war service, pack saddles of the best sort should be provided to carry only two boxes (for if you put three boxes you will over-weight them for the march). Then you

will be able to bring them to the rear of every battalion, either under fire or in preparation for fire. In connection with this, Lord Hardinge wrote as the ground-work, and tells it very well:—"The first reserve small-arm ammunition would then be carried on mule back, with European soldiers of Land Transport Corps as conductors. A second reserve in artillery waggons, with six horses, each having 60 rounds per man, and 90 rounds in action, making in all 150 rounds per soldier." "At Almanza, Lord Peterborough's Army of 10,000 British troops was obliged to lay down its arms for want of ammunition; and I myself have seen 17,000 men men in great peril from the same cause." Therefore Lord Hardinge was also anxious that by mule back and wheels, the ammunition should be ready close to a battalion. He also makes another very pithy observation. "Troops may starve for twenty-four hours, but if for an hour they are deficient in ammunition, they are likely to be defeated." Those are Lord Hardinge's opinions with regard to the first reserve of small-arm ammunition; and I hope they will have some weight in the preparations that are now taking place.¹

Lieutenant-Colonel R. HARRISON, R.E.: I should not presume to take up any of the time of this meeting were it not that nine years ago I read a paper at the War Office proposing that a company of engineers should be formed of a strength of between 200 and 240. I have lived to see five companies actually made of the strength of 202 Officers and men. When I wrote and asked whether the paper I had read might be printed, I was told that there was *no objection*, but that the use was not seen of starting a hare that *could never possibly* be caught. Well, this hare has, as I have just said, been already caught, as far as the engineers are concerned. Not being present at the first part of the lecture, I do not know exactly what Colonel Clive has put forward as to the *strength* of the company he proposes, but I am satisfied that he has done the right thing in bringing the subject forward for discussion. As to the *actual size* of the company I will not offer any opinion. All I wish to say about it is this, that the company should not be *so strong* as to be out of a man's hand, whether in the field employed tactically, or whether he is administering it in the barracks or the camp, and it should not be *so small* as to be actually insignificant. I myself have been commanding companies and similar bodies for twenty years, and I am commanding one still. On one occasion I remember the company I commanded was so reduced in numbers that I only had three men on parade to march to church after a volunteer band that the company possessed. *That company* was, no doubt, a *great deal* too small. On the other hand, I have *now* under my command 317 Officers and men and 225 horses. No doubt this unit would be a *great deal* too large for *infantry* to be commanded efficiently in the field. But I mention it as a practical example of how large a body *can* be commanded administratively in barracks. Certainly I have very good Officers and non-commissioned officers, or it could not be done. As I said before, I do not know *exactly* what Colonel Clive's scheme is; as a question of principle I perfectly agree with him, that is to say, it seems to me that the organization of the Army should be such as to *decentralize*. Responsibility should be thrown on *all* Officers from the time they join the Service, and on all non-commissioned officers from the time they are appointed; for by such a system only can the training, which is so important of all ranks, be thoroughly carried out—by such a system only will a General be able to command such a complicated thing as an army in the field in the present day; and by such a system only will every individual in the Army be able to carry out his own education, until by industry and diligence he renders himself fit for any command whatever.

Mr. C. B. NORMAN: Sir William Codrington is the only Officer who has touched upon the question of supplying ammunition in the field. As I have recently had an opportunity of seeing mule transport used during the Russo-Turkish War, and prior to that had the opportunity of seeing troops served with ammunition in the

¹ Although I did not mention the following, it is also on the same subject in Lord Hardinge's letter:—

"At Albuera men's pouches were replaced a third time. At Waterloo, La Haye Sainte was captured by the French, owing to the failure of a fresh supply of ammunition."—W. C.

field, I will say one or two words. It seems to me we do not lay enough stress upon the value of mules. There is a plan that has been tried upwards of thirty years in a portion of the British Army; it has stood the test of thirty separate expeditions on the frontier of India, as well as that of the Indian Mutiny, and I have never heard that the supply of ammunition failed the battalions of the Punjab Frontier Force. Every regiment in that force has 40 mules and 55 camels under the charge of the Quartermaster, a combatant Officer. The drivers are non-combatants. To these 40 mules there is 1 jemidar and 13 syces. Sixteen of these mules are told off for service ammunition; each carries two boxes containing three leather cartouches, which may be slung over the back of a man, and so pushed forward to supply skirmishers in the field. Each cartouche contains 35 packets, that is 350 rounds: thus each mule carries 2,100 rounds, and the sixteen 33,600, which is about 48 rounds per man taking the total strength of the battalion at 720; but as a battalion rarely goes into the field at its full strength, it really would be 50 rounds per man. In that column of the Jowaki Expedition referred to by Colonel Clive, the mules did not belong to the regiments, but in the force under General Keyes (the Kohat column) the mules did belong to the regiment, and each man had a reserve of about 50 rounds close at hand. I think that system perhaps is preferable to the one before us. The cartouches are ready filled, packed in the boxes, and when the ammunition is wanted, the Officer has merely to send a messenger to the mules' escort to ask for ammunition. These mules may be pushed up in hilly countries very close to the fighting line; the men have simply to take out the cartouches and run up to the front with them. There are many Officers here who have seen that done in service. I think we might take a hint in a good many ways from the way in which troops are equipped in India; but really I think the mule carriage of ammunition throughout is infinitely better than anything I have seen, either at Woolwich or with the Turkish Army, where there was no regularly organized system for supplying the troops in front. Some mules carried two, some four boxes; there was no authorized number; men ran back from the front, smashed open boxes, and picked up the ammunition as they could; but the system in vogue in India, and which might be tried at Aldershot now, you would find answer all the purpose. There seems to be a general consensus of opinion that now is not the time to alter companies; but now, with war staring us in the face, I think is the time to try every plan that can be brought up for supplying troops with ammunition in the field, and a plan that has stood the test of war is worth a trial.

Captain FRASER, R.E.: I should not have ventured to have expressed an opinion on this subject, but that, with a full knowledge of the importance of the question, I have lately been watching its practical solution in action, and having done so, I can fully confirm the view expressed by Colonel Brackenbury as to there being very little field for control when infantry come to close. Personal control over 100 or even fewer men in line of skirmishers, when thoroughly engaged, is, I venture to think, out of the question. The moment for control is then over and that for example has come. Success, it seemed to me, was at this stage chiefly due to the example of the bravest individuals and to the presence among the rank and file of such an instinct for fighting as seemed to give them all something of cohesion: and this, I think, is one great reason why the Turks did so well in the attack. We have been in the habit of believing that they are only good for defence. They believe the contrary themselves, and I have heard their view concurred in by German Officers who had seen them fight both offensively and defensively. The reason I take to be that Turkish soldiers have such a natural aptitude for fighting is that they go forward whether led or not. All important as the question of company organization is, as a means of launching troops most favourably into action, I still think that ultimate success will, in the main, depend on the fitness for fighting that there is in the masses; and this we should endeavour to develop in the individual by constant practical training. With regard to long-range fire, I did not myself see such results as have been mentioned. No doubt it has an enormous moral effect, because men are shot without any apparent cause. When you see men firing at you at 200 yards, you expect to be shot, and those whose comrades are shot alongside of them at all events do not then mind it so much. It is worth considering whether the moral effect of long-range fire has not caused the physical effect to be overrated. General Skobelov

complains that the Turkish infantry would not let his masses alone at a distance of 2,000 yards; but it did not much matter whether they did or not; because the existence of masses in the presence of artillery would be impossible at such a range. The question of supply of ammunition I believe to be all-important. In countries such as Turkey, it would constantly be impossible for us to drag about the heavy transport we have designed as it is for the ordinary roads of civilisation. At the battle of Kaczevo the Russians left an ambulance waggon which had been presented by some society. It was a modest vehicle, measured by the standard of London, but when we saw it there it looked like the ark on Mount Ararat, nobody could make out how it got there; everyone could see why it had stayed. So it would be with our heavy transport, and we must, I venture to think, be prepared if the ammunition is to follow troops in action, to put it altogether on horses. It is wonderful what may be done in this way. I lately saw ammunition pack horses advancing almost in the line of skirmishers; they ought to have been shot, but somehow they were not. Each company had its own pack-horses led by men of the company. Everyone fresh from the experience of the late war, will, I think, agree that we cannot attach too much importance to this part of Colonel Clive's subject on which Sir William Codrington has just thrown such an interesting light.

Lieutenant-Colonel СВИСЛОТ, Grenadier Guards: It appears to me a great many of those Officers who have spoken to-day have rather put aside the question, what are we to do in the way of training men for fighting. Are we right in our present system, and is the present extension of the company too large or not? I maintain as an old Adjutant and now as Captain of a company that, in the first place, as an Adjutant, men, and especially young soldiers, get thoroughly confounded when supported and reinforced by other companies. If you extend a company over seventy yards, and a Captain commanding another company comes up to reinforce, the fighting line has possibly another commander, the men are mixed, and they do not know who to rely on; "Which Officer shall I take the word of command from?" I have heard fifty times in Hyde Park. If that is the case in Hyde Park, what must it be in a regular action. If you reinforce them from the rear with one or two other companies, the confusion becomes proportionately greater. I have tried a battalion thus:—On my right hand, the right half-battalion extended for attack, as per regulation drill book, one company covering its front, one in support, remainder in reserve. On my left hand, the left half-battalion with its front covered by sections of each company, extended, supported each by sections of the same companies, and with reserves made up of the rest of the half-companies. And I have no hesitation in saying the left half-battalion working in sections extended, supported by its own sections and with its own sections and with its own reserve worked steadier and better and was better in hand during and at the end of the action than the right half-battalion which was working by one large company extended first, reinforced by another company, mixed, and reinforced at the last by the rest of the half-battalion. I think I may add, I have seen a good deal of Volunteer fighting in Hyde Park, at Tring, and other places. As soon as the companies in the front fighting line were reinforced, confusion reigned supreme, there was not a chance of getting the men back or under control. I do not intend to speak against the auxiliary force. I do not suppose any of us imagine that they drill quite so smartly as the Rifle Brigade or the Guards; they do drill remarkably well, but at the same time, extend them and reinforce so as to mix companies, and I would like you to see where they get to in a sham fight in a quarter of an hour. 2ndly. As a commander of a company, my company as a rule in peace-time is extended to cover the front of the half-battalion, about 120 yards. I have very strong lungs, I have a very smart non-commissioned officer, but I have never been able to control that front properly as a Captain. In the larger company let me extend a quarter of it and I will control it; let me reinforce it by my own men, I will control them. Let me reinforce it from the rear half-company which I would have commanded by a second Captain to my company, and I would control that too. I would not reduce the number of Officers, we want Officers, and smart non-commissioned officers, in the same proportion to numbers as now, but if with such Officers I had the command of a company, of say 200 men, as Captain in time of

peace, I believe we should be able to command them thoroughly well on active service.

Note.—I intended to recommend, but had not time, as a step towards the larger company, a double company system *pro tem.*, that is, making two of our small companies always work together under one distinct *double company commander*, I would never allow those companies to be separated in attack drill and gradually I would blend them into one company of 200 men. This would not be at variance with our drill book, but it would make *compulsory* what is now *optional*.

Lieutenant-Colonel HALE, R.E., in a few brief remarks, supported the adoption of large companies.

Major-General R. LUARD: There is one point which I think has not been quite sufficiently brought forward. What I should like to see is more responsibility on the part of corporals over their squads and of non-commissioned officers in charge of squads. And I will go lower than the corporal of a squad: let there be comrades *always together*, and in reinforcing the skirmishing line let the men be reinforced by men of their own squad, *their own comrades*. As the men live together, let them fight together "*as comrades*." I do not think this point has been sufficiently brought forward, and it is a very important one. Take the company drawn up in line at whatever distance from the enemy; for the attack let a few men (say from the right, left, and a central squad), well in hand of a corporal, be sent out to feel for the enemy. When these men require to be reinforced, let this be done by their various squads, and when the line has been reinforced up to its full strength, the squad would stand in line of battle all together, so that every squad would have its *own* non-commissioned officer over it, every sergeant would have so many (and his *own*) squads under him. The subalterns would have so many sergeants' sections, making up their *own* subdivision under them, and the Captain would be there to superintend the whole—his *own* company. By such means when the company has finally been reinforced to the full amount, the men will be under their own Captain, and not under several and strange Captains. The result of the present system would be very well exemplified if each company of a regiment had different coloured caps, for when the reinforcements took place according to the present rules, you would see at a glance at the end of the final reinforcement, how the red caps, the white caps, the blue and yellow caps were all muddled up, whereas by the system I advocate the same coloured caps would be together, and at the supreme moment, when you have either been successful (or, unfortunately, you may not have been successful), and you want the company to act as a company under its Captain, you would then have them all together and quite handy. The comradeship and the squadding together are points which I do not think were brought forward to-day, and those are the points I wish to bring to your notice.¹

Captain GUNTER, 59th Regiment: There are only one or two remarks that I would venture to ask to be allowed to make. As a Captain of infantry I feel that with our present battalion organization our commands are too small for tactical requirements,

¹ I am not for increasing a company beyond what a Captain can well control by voice and gesture in time of battle (which I put at *about 100 men*). What I advocate is, that when in that line of battle, in order that the men may be *well in hand*, they shall find themselves alongside their comrades: and for this I would build up the company of a certain number of corporals' "squads," men who are *always* together, in barracks, tents, on parade, and in the line of battle. The "attack" to be made by sending forward a few at a time, so that when augmented up to full strength, each squad may find itself complete, irrespective of its relative position to other squads in the company. Comrades, double comrades, quadruple comrades, &c., under a corporal to form the "squad," and twelve squads, say, to form the company. Advances to attack, and more especially retirements after attack to be practised *continually by alternate squads*. All battalion and company movements to be subordinated to the system of attack and comrade formation. Sizing to be by squads, *not* by companies. Equalization of companies to be discontinued. Everything to teach that *as squadded*, by comradeship, *so must men fight*, under their own non-commissioned officers and Officers, and to impress this the more thoroughly, so must they "march past."—R. G. L.

and that larger companies would offer advantages for administration and training. At the same time I think the proposed change to four companies would give companies too large for efficient command in the field. I would venture to ask whether a useful tactical reform might not be effected by simply reducing the number of companies from eight to six, the battalion of the present strength being retained. The company might stand at war strength somewhat thus :—1 Captain, 3 Lieutenants, 3 sergeants, 3 lance-sergeants, 6 corporals, 6 lance-corporals, 3 drummers, 3 bandsmen, and 3 pioneers, and 144 privates; total, about 170. Divide this company into three platoons, each commanded by an Officer, and each platoon into two sections, each commanded by a sergeant or lance-sergeant; each section into two squads, each commanded by a corporal or lance-corporal, the basis of the system being the squad of 12 men. I think the company thus formed will be found very handy for all purposes. For purposes of attack allowing about 20 per cent. for casualties before going into action, your platoons would be about 38 strong, and if you allow about two paces between the men, each platoon extended in single rank would occupy 114 paces. You might have a right and a left attack, one company in front of each attack extending two platoons in front (the Captain keeping one platoon 100 yards in rear of these as a reinforce). Two companies would cover the front of the battalion. A company extended in support about 200 yards in rear of each front company, its Captain also keeping one platoon in hand 100 yards in rear of the outer flank, to guard against any flank attack. The right attack to be commanded by the Major of the right wing, and the left attack commanded by the Major of the left wing, the commanding Officer keeping two companies in hand as a local reserve. That is merely an ideal formation. If it is considered that the companies should find their own supports, three companies might each extend one platoon in front, one platoon in support, and one in rear, the Commanding Officer keeping three companies in hand in rear for counter-attack, reinforcement, &c. I do not think myself that the system of the company finding its own support answers so well as having the supports of a separate company; but if it (the former) is considered better, the organization by six companies would be equally well adapted to that.¹ I think there is one thing very important, and that is that the Captains should be allowed to instruct and train their companies; they should frequently have opportunities for thorough company instruction, and to do that the Captain should be assisted by a non-commissioned officer—a company sergeant-major, who should be entirely relieved of pay duties, so that he may devote himself to the disciplining and instruction of the men. The object should be to get a thoroughly efficient company so as to give the parts of it sufficient strength to afford sufficient employment to the subordinate Officers and non-commissioned officers.

Colonel CLIVE: I regret that owing to the number of Officers who have expressed their views, and the range of subjects over which the latter have extended, that I shall not be able to answer my opponents in detail at this late hour.

I understand, however, that we are all agreed that the supply of ammunition is most important, and well worthy of experiments, with a view to ascertaining the best system for our Service, both as regards the mode and means of carriage, of distribution, and the machinery by which the latter is to be made; in other words,

¹ Among the reasons against forming the supports of the same companies as the skirmishers may be stated :—

1. Owing to the great difficulty of *direction* in fighting in extended order (especially in wood fighting, *e.g.*, Wörth, Spicheren) the "supports" are after a while frequently found arriving in rear of other bodies than those in support of which they started. If formed of the same company as the skirmishers in front, a dislocation of the company thus ensues, which would not follow were they of a different company. In the latter case the supports being still whole companies keeping together, it does not signify so much. In the former case the *parts* of companies become widely separated, which is a great inconvenience.

2. The greater difficulty of keeping the men of the supports when excited from rushing on to join their comrades in front if of the same company, and prematurely taking part in the fight, which is productive of much mischief.

3. The difficulty in practice of directing both skirmishers and supports.—E. G.

whether the men that are to convey the ammunition shall belong to the company or to the battalion pioneers—buglers or drummers.

With reference to the tactical questions to which the larger number of Officers have spoken, it seems to me that the objections raised may be conveniently classified under three different heads :—

- (a.) The demerits of the four-company system ;
- (b.) The merits of the eight-company system ;
- (c.) The objection to making any immediate change.

(a.) Speaking first and principally to the first objection, the difficulty of control. General Beauchamp Walker (in whom I am sorry to find an opponent), states that the Germans have realized that Officers cannot remain mounted under fire : that a German company is too large for effective control on foot, and that, therefore, we should not increase the size of our company. To that argument I answer, that in the last war, after the first fortnight, the German Captains *did* dismount when going under fire, and yet did succeed in commanding their companies to very good purpose.

A letter from a Staff Officer at Berlin, received this day, states :—

“ In the beginning of the war our Captains of companies remained mounted while under fire. Great numbers of them were killed or wounded in the great battles in the vicinity of Metz. For this reason they were ordered to dismount and command on foot. Since that time, companies have been commanded on foot, and no particular difficulties have resulted.”

And again, a Captain in a Jäger battalion at Amannvilliers, which lost 550 out of 900 men, in killed, wounded, and missing, relates :—

“ For the most part the Captains were not mounted in the fighting line. We generally rode until we came under fire. On foot it is certainly hard to command a complete big company : but our task is lightened by the knowledge possessed by our Lieutenants. But how often is a company complete ? For instance, at the commencement of the war we used to parade about 250 men. There were always some sick, foot-sore, orderlies, &c., and after the first fight, you don't find more than 120 men or thereabouts. Therefore, personally I am convinced our present sized company is none too big, and to know all your men well, as we do, helps matters immensely. When our reserves join, we post the men to the same company in which they formerly served.”

I am glad to hear General Walker say, that in his own branch of the service, cavalry, he is in favour of the squadron being the administrative as well as the tactical unit, adding “ I prefer a large unit for cavalry,” and it appears to me difficult to draw a distinction between cavalry and infantry in the matter of fighting tactics. Major-General Cox considers a unit of 200 men unwieldy ; but, as he fixes 140 men as the most suitable strength for a unit, he probably considers our present company too weak.

(b.) Colonel Blundell, on the other hand, is satisfied with the present strength of the company, but considers the battalion too large, and, therefore, would adopt the half-battalion as the unit, with the present company as it is.

Many distinguished Officers have testified to the efficiency of our present-sized companies. Colonel Brackenbury speaks to its suitable size for bush fighting and small frontier wars ; though I do not gather from his remarks that he would recommend it as a suitable organization with which to meet a Continental Power. Sir William Codrington, in speaking for our present companies, yet allowed an expression to fall, which leads me to suppose that he would like a company to furnish its own skirmishers, supports, and reserves ; a principle which I was most happy to hear affirmed by an Officer of such distinguished service.

(c.) Lastly, all Officers have unanimously objected to making an immediate change.

Gentlemen, I hope you will think me sincere when I say that I never contemplated such a thing. Such a change in organization will require much thought and many experiments. And, moreover, much in what I believe to be the right direction, may be accomplished by working with the double company columns, *so long as the same two companies are always worked together*, in quarters, at drill, and at manœuvre, and, if possible, on detachment ; in short, if we apply our

present cavalry organization to our infantry. I advocate big companies for our service in peace and in war, for three reasons:—

- (1.) Because our battalions are too big to face the breech-loaders ;
- (2.) Because our companies are too small ;
- (3.) Because the mixing of men is, under the big company, materially diminished, and the power of control is increased.

The first statement is already sufficiently proved : and, although, I do not wish to recapitulate arguments, I must give my reasons for thinking our company too small. Our Chairman, Sir Garnet Wolseley, referred, about two months ago in this hall, to his own experiences in India.¹ He made three statements in the course of his remarks. That no man could personally influence men under fire for more than 50 yards on each side of him, or 100 yards altogether. That he had found, by experience, that when he had been a very short time in action, from one-third to one-half of his men were no longer under his personal control, not necessarily killed or wounded, but simply not available or subject to his influence, and that in future a Captain's command must consist of depth as well as front. Let us consider the fighting value of such a company. If a company, 100 strong, marches off parade with 75 or 80 bayonets, it will be most satisfactory. After a short time in action, from 25 to 40 of these will no longer be to the front, and there will remain some 40 or 50 men, with the work about to begin at 500 yards from the enemy. If this is the best evidence in favour of small companies when attacking sepoy with muzzle-loaders, I regret that I cannot consider it a strong case. I say the present company is too small, because there is nothing of it by the time the work begins ; and when the supports come into line, control is rendered more difficult, and with the entry of reserves in the fighting line, control is nearly impossible.

In reading the German instructions for manœuvre, I find them full of general sound principles and of large views, and only one thing strictly forbidden, and that is mixing the files "eindoubliren rottenweise" in the front line. Control is at all times most difficult of retention, they say, and the only chance of doing it is to keep the sub-units unmixed as long as possible.

It is, then, because a large company can play the part of a small battalion, or as well as that of an efficient company, being a mean between our battalion and our company, and will, at the same time, reduce the reinforcing difficulty to a minimum, that I advocate it as the best organization under which to meet the breech-loaders.

This system happens to belong now not only to the Germans, but to the French, Austrians, Italians, Belgians, and also, I believe, to the Turks : and, as I cannot find any weak point in it which is not as weak if not weaker under other systems, or, turning to our Service, any conditions which this European system is unable to satisfy, I should like to see experiments tried, with a view to ascertaining whether it will not also confer advantages upon the British infantry.

The CHAIRMAN : Well, gentlemen, I am sure although we may have differences of opinion as to the relative merits of strong companies *versus* small companies, we shall all agree in feeling and thinking that the lecture and discussion which has followed it, have been most interesting and valuable. I am very glad indeed that this discussion has taken place. I fully concur in the views expressed by Colonel Clive as to the discussion, and to the advisability of its taking place to-day. The real and principal reason, however, why I am glad it has taken place is this : I should have been very sorry indeed if Colonel Clive's interesting lecture of last month had been published in the Proceedings of this Institution and had gone abroad and been read all over the world without being accompanied by any statement from those who do not concur in the views he advocates. I fully concur in what has been said by so many here to-day as to the inadvisability of making any alteration of system whatever, when an enemy is preparing for a campaign ; and we all know that at this present moment affairs in the world are very critical. We have been told that war hangs in the balance, and we know not the moment when we may be forced into it. It would, therefore, be madness to attempt any alteration in our system of drill at present. I think it was Colonel Brackenbury who reminded

¹ See Journal, Vol. xxii, No. 96, page 580, *et seq.*

us of a very witty saying of the late President Lincoln when he was questioned as to the advisability of changing Commanders during the American War. But if it be dangerous to change your General during a campaign it would be still more fatal to attempt any change in the organization of our Army at a moment like the present. I will go further, and will add that with all due respect to Colonel Clive, for whom I have the greatest possible respect, I think the fact of this question being brought forward at all at the present moment is to be regretted, because I am afraid those who read his lecture may be liable to have their minds warped and biased by it, and their confidence shaken in the system in which they have been educated, a result that no one I am sure would regret more than himself. However, on the whole, I think the discussion has been most useful; and although I am neither judge nor jury at the present moment, I cannot help feeling that the balance of argument has been in favour of the views I myself entertain. When I think of the lecture we heard from Colonel Clive a month ago, and of the views he has brought forward to-day, and of those that have been propounded by others who defend the system of strong companies, I cannot help thinking the whole of their arguments might be almost reduced to a single one, which is this, that because the Prussian Army in 1866, and the Germans of 1870, were eminently successful, and because those two armies were organized upon the four-company system, therefore that system is much the best organization for an Army. I think that is really the whole pith of the arguments that have been brought forward. To say that the Prussians were successful on account of their battalion organization is, I think, to beg the whole question at once. We are all entitled to our opinion, and mine is in this matter that it would be quite as logical to attribute the success of the Germans to the fact of their having spiked helmets. They were successful, not because they had strong companies, but in spite of that system which I believe to be a thoroughly faulty one. One argument brought forward in support of Colonel Clive's views must, of course, be recognised by all as a strong one, it is that nearly all the Continental nations, all the great military nations of the world, have copied this system which he urges us to copy: France, Italy, Austria, and so on, have adopted this four-company formation. That would be a very strong argument in its favour if it were clearly brought home to us that this strong company system had its origin in the changes brought about in tactics by the introduction of the breech-loader into modern warfare. But so far from this being the case, I think if you will go back into history, you will find that this strong company organization existed in the Prussian Army long before breech-loaders were ever thought of. It existed in the Prussian Army when they manœuvred in strong columns and in thin lines. If you wish to account for the origin of the strong company system you must go back to the time when the Prussian nation realized the necessity for having a large Army. Prussia was very poor and very weak in that class of men from which alone they would consent to draw their Officers. In Prussia a man is not allowed to be an Officer, or certainly was not allowed to be one in those days unless he had a certain number of quarterings to his arms. The country was poor, and they were determined to have a large Army. How did they do it? In this way: they increased the number of men in their companies without increasing the number of their Officers. The Officer is a very expensive animal, whilst the private soldier, in an Army where soldiers are supplied by compulsory service, and where obligatory service is the law of the land, costs directly almost nothing. The Officer is expensive because he has to be paid well and pensioned off. That was really one of the principal reasons why the Prussians hit upon this system of four companies for their battalions; they increased the number of men in each company in the Army, but they did not increase the number of their Officers. They also suffered from a great dearth of Officers. Supposing they had said, "We will still maintain the proportion between Officers and private soldiers in 'each company,'" they could not have found the number of Officers required for this large Army. It was, therefore, from poverty of material from which they would alone consent to manufacture Officers that this system came into operation; and I would above all things beg young Officers in our Army, who are influenced by the views brought forward in pamphlets and books upon this subject, to remember this historical fact, that the strong company system has nothing whatever to do with the introduction of breech-loading arms into the Prussian or any other Army. I think

that those who recommend this system of strong companies may very fairly be divided into two classes. First we have the enthusiastic soldier, the man highly devoted to his profession, of which my friend the lecturer and many others who have also spoken here to-day are distinguished examples—men who are sincerely desirous of making themselves efficient as soldiers, and of seeing our Army the best and most perfect in the world. The second class is far more numerous: that might easily be the case however, for I believe the number of men in our Army who defend this strong company system is very small. The second is a much larger class, and it is amongst civilians, not amongst the military, you must look for them. It is the class of would-be army reformers—men who know nothing about war or soldiers, either theoretically or practically—men who are strongly biased—certainly many of those whom I have in my mind are so from political motives, against the British Officer generally, and who would therefore like to see their number reduced. Of course the great peg that the class of army reformers to whom I refer hang their opinions upon, is the principle of economy; they urge that the smaller the number of Officers the less the Army will cost. Economy is a subject it is very easy to preach upon. Englishmen are always very glad to listen, and John Bull is very anxious to give you a good hearing if you can propound a theory by the adoption of which it is proposed to reduce our Army expenditure. If you tell him that by following your advice he will have less taxes to pay, he naturally begins to think there is something in it, but when he is told that the system recommended to him, that of having only a small number of Officers is the system of the Army which has been the most successful in the world, and further that there are a certain number of men in our Army who advocate it, he naturally imagines there is some truth in it. He allows himself to be carried away without really knowing anything of the subject. Most of our army reformers advocate the four-company system simply because it commends itself to their notice through the saving in expenditure it would bring about, and because a few distinguished Officers, like my friend the lecturer, recommend it. Before going any further into the question, I should like to deal with this subject of the proportion of Officers to men, because that is the most important part of the question, and I would like to call attention to the manner in which I believe it would affect our Army. I had hoped that General Walker would have made some allusion to what I have always understood was a fact, that during the progress of the late war there were considerable complaints in the Prussian Army as to their paucity of Officers.

General BEAUCHAMP WALKER: The greatest possible complaint.

The CHAIRMAN: That was a point on which great stress was laid at the time. Now, if the German Army suffered from a paucity of Officers during their wars, just think of what would be the result in our Service of a reduction in the proportion of Officers. Remember the great distinction between the rank and file of our Army and those who compose the Prussian Army. In every German battalion or company, there are men drawn from all classes of society; you have the rich gentleman's son, the sons of the landed gentry, the sons of the professional man, the mechanic and labourer; whereas on the other hand in our Army where voluntary enlistment holds good we almost universally draw our men from the poorest class of society, and I may add, without wishing to say anything derogatory to the rank and file of our Army, from the most ignorant class in England. We tap only one stratum of society, whereas for the supply of men to every battalion in Germany every stratum and class of society is tapped, and the consequence is the higher intelligence of the few and the superior position of the few go to leaven the mass. The result is the mean intelligence of the men composing the Prussian company is much higher than in an English company, and I think everyone will admit that the higher the intelligence of the men, the better they are educated, the higher the social position they occupy in private life, the more easily they are commanded in action and the fewer number of Officers they require. I am sure it will be admitted that our men require more Officers than the Prussians. We are told the Prussians suffered from a paucity of Officers, and if they did, how much more should we.

There is another point connected with this part of the subject as it refers to the composition of the Prussian Army. In that Army the non-commissioned Officers

are drawn from a better class, they are better educated and therefore command much greater respect and have greater influence amongst their men than ours do. If an Officer is killed in the Prussian company, a non-commissioned officer is far better fitted to take his place than a non-commissioned officer in our ranks is. Any one here who has had much experience on active service, and who has lived, I may say, in the ranks among his men by day and night for months and months together, will recognise the truth of this, and he will, perhaps, as I can remember having heard men say, that they would infinitely prefer following the youngest joined ensign to the oldest non-commissioned officer in the regiment. If that is true, it is another reason why we should pause before we attempt to introduce into our Army any system that would tend to reduce our Officers. What I am afraid of is, that if a proposed scheme of this kind, recommended by men like Colonel Clive and others who are students of war, goes forth to a public eager for economy, this four-company system will not be judged upon its own merits, and will therefore obtain a far greater following and a far greater number of adherents than hitherto, a cry will be made to reduce the number of our Officers, and I think that no step could be more dangerous.

Colonel CLIVE: Nothing has been said about lessening the number of Officers.

The CHAIRMAN: No allusion has been made to that subject, but the two things go together, and the very fact of that not having been alluded to makes it all the more dangerous, because if this system of four companies is adopted it will most certainly lead to a considerable reduction of Officers, whether those who recommend that system from tactical reasons wish it or not. In discussions on this subject we hear a great deal about "the tactical unit." I am referring not only to the general remarks made here to-day, but also to what I have seen written about it by others. I should very much like to go round this hall and ask every man his views as to what the tactical unit consists of. I do not believe a great many have very decided views as to what a tactical unit is. As I conceive a tactical unit in infantry, it is the maximum number of men that one captain or leader, whichever you choose to call him, can actively control and lead in action. That is how many men around you can you influence? To what distance to your right or left do you influence men? If the number of men in your company, when in fighting formation, will cover a greater space than you can influence by your own presence, I say you ought to reduce the number in your company to the number that can conveniently go into that space. There is a limit to the front which we can exercise influence over, and in these days of skirmishing we know the number of men that can go in that space is very small indeed, much smaller than formerly, therefore the deductions I draw from the late wars is not that you should increase the number of your men, but that as in future all your fighting must be in skirmishing order, you should reduce the number in each company. In any given front, whether 50 or 100 yards be assumed as the limit of front over which a Captain can exert a direct influence, you cannot have as great a number of men as you used to have in former times, when you worked in close formation. The deduction I draw consequently from the late war is, that your company should be smaller than it was in those days. In former times the battalion was the tactical unit in all armies in the world. A battalion then consisted of 400 or 500 or 600 or 800 men. 600 or 700 men when in column, or formed in a rigid line, could easily in those days be commanded by a man on horseback. I think there is a consensus of opinion as to the impossibility of a man remaining on horseback under the musketry fire of the present day. A man on horseback is an impossibility under a heavy musketry fire; he would be a great target that would only exist for a very short time. In coming to an opinion on this subject you must assume it as a fact that a man cannot remain on horseback now. In the days when a Colonel rode with his regiment and commanded his battalion in line or column of 700 or 800, the noise was much less than it is now. In those days of muzzle-loaders the firing was very slow and the danger very slight compared with what it is at present, but now you can scarcely make yourself heard to a distance of more than a few yards away from you. In the Ashantee campaign, such was the continued roar of the breech-loaders, that upon several occasions one had to shout at the man near to you to make him hear. If that was the case in a small petty war, picture what it would be in a field of battle where 20,000 or 30,000 infantry are continuously

firing; it would be impossible for a man to make himself heard to any distance, whereas in those days of muzzle-loaders a man on horseback could make himself heard by his battalion. Now if a man can neither make himself seen by being mounted, nor heard to any distance owing to the roaring voice of the breech-loader, all this points to the fact that your unit should be much smaller than it was in former wars. We are all agreed that in future men can only fight in skirmishing order. The days when men advanced in line as at the Alma and elsewhere are past and gone. We must make up our minds that an action will in future be fought out by two great opposing irregularly formed lines closely packed at places and very thinly occupied at others, swaying backwards and forwards many times during the progress of the battle. Formerly one line could advance up to another almost within charging distance in close formations, but this cannot be done now. Colonel Clive laid great stress upon the assumed facility with which you will be able to control your men by having a small number of large company units. I arrive at a very different conclusion. My theory is, that when once your skirmishing line is thoroughly well engaged with the enemy's skirmishing line it will be from the rear impossible to exercise any real control over those men whatever. Each Officer in the skirmishing line will exercise considerable influence over the men near him, but those in the rear, the Colonels and Majors and the Captains, even as long as they remain with their supports, can really do nothing to control them. If they wish any new attack made, it can only be made from the rear by fresh troops being sent up to take part in it. I am sure Colonel Hale will agree that all the works that have been written upon the subject of the late wars in Germany tell us the same thing—it was already put in the extract Colonel Blundell read—and it is this, that confusion is an inseparable part of all fighting in future, no matter how you organize your battalions or companies, or how you support them. Your first line when actively engaged will always be in a sort of chronic state of confusion, and that under the most unfavorable circumstances of noise and excitement. My idea is this, that the smaller your unit, the more easy it will be for the Captain in the skirmishing line to control it and to rally it. Colonel Clive referred a great deal to the confusion that would exist when his¹ reds and blues and browns got all mixed up together, but my idea is the Captain of the blues would find it much easier to rally his blues and the red Captain his reds in a line such as that if he had only to rally and collect together 50 or 60 or 70 men, instead of having to attempt to rally 200 or 250. I think when strong companies are mixed together, it would be absolutely impossible during a partial lull in the engagement to attempt to rally your company, and we all know in that critical moment that takes place in every successful action—the moment you have driven your enemy off, or seized his position—the absolute necessity there is at once to collect your companies together. Picture to yourselves the confusion that exists then, and you will see how much more easy it would be to rally a small company than it would be a large one.

Colonel Clive referred to the remarks I made in a previous lecture upon this subject, and he quoted what I had said so very correctly that I shall not recapitulate it. I will only add that if when in command of 100 men in action, I found the impossibility of controlling them when in skirmishing order, and that if during the progress of an action when both sides were armed with muzzle-loaders, I upon several occasions lost sight of a large proportion of my men, sometimes for hours together, picture to yourselves what my position would have been if my company had consisted of 250, instead of 100. What command should I have had over 250 men? I flattered myself then, as every Captain does, that I was able to impart some of my spirit into those I commanded, but I should like to know how you could do that if your line is extended over the distance 250 men would occupy in skirmishing order? I look upon it as an utter impossibility. Colonel Clive made a remark that I must say I do not agree with. Almost the last remark he made before he sat down was that we ought rather to apply our system of organization to suit great Continental wars that may possibly be forced upon us once during a century, in preference to suiting our organization to the small wars that we have, not once a century, but I may say almost every succeeding year as it passes by. We know that as a nation

¹ Referring to coloured diagrams of companies moving up as supports, reserves, &c.
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we are the only one that is really always at war. I do not think there is ever a year in which there is not some small colonial war going on—some Abyssinian or Ashantee, or some other small expedition; we are fighting the Jowakis in the north of India, or we are preparing to fight the Chinese; there is always some small warfare going on in our very extensive Empire. I therefore differ entirely from Colonel Clive's views on this point, for I think we ought to make our organization and our system of drill to suit the warfare that is in fact our normal condition of existence, and not the abnormal wars that perhaps once or twice in a century may be forced upon us. I think if any gentleman here who has taken part in many of our small wars will think over his experiences in them, and if he will consider what the effect upon himself would have been, how he would have managed if his company had been 250 men, or how the system would have worked at all if every company in the army operating during those small wars had consisted of 250 men, I am inclined to believe he will lend to my opinion. Take India for instance, a country where we are continually fighting. A very common brigade in India is one European regiment and two, three, or four battalions of native infantry, perhaps artillery and cavalry. Without saying anything to depreciate the native troops, we all know the backbone of that force is the battalion of white troops—they are the point of the sword. You wish to detach a small part of your European force as an advanced or rear-guard. You have only four companies in your battalion, and you have consequently to send a company; you lose one-fourth of the troops upon whom of course you rely most. The next detachment takes another fourth, and you are left with only half the battalion. If you think of that result you will concur with me in saying that eight companies of about 100, or 80, or 70 men is a far more convenient establishment for troops engaged in a small war, where the brigade consists of one battalion of white troops and three or four of natives. Take for instance outpost duty; how very inconvenient with only one battalion of white troops it would be if obliged to furnish outposts from it for such a force. If, as I believe, our present organization is more suited to small wars and bush-fighting, than the organization which has been advocated by Colonel Clive, I would wish to ask, is it not much better suited also to our Reserve Forces? This is a point that has not, I am sorry to say, been referred to by any one during the discussion. How about applying this strong company system to our Militia and Volunteers? I think it will be generally recognised as an axiom that it is absolutely necessary, whatever system of organization you have, that it must be one you can apply to all your military forces throughout the world. I do not wish to say anything derogatory to the Reserve Forces. I had the honour of being connected with them for several years, and I know all that can be urged against them; but remember how very small the opportunities are which a Captain of Volunteers or Militia has for learning his work. I very much doubt if there are very many young Captains in the British Army who could effectually command 250 men, but hand over 250 men to a man who only serves 28 days in the year, or to a Captain of Volunteers, who perhaps only attends parade once a week, how is it possible for him to acquire the method and manner of command that is necessary for the command of 250 men. I do not think it would be possible. As I read the history of the great wars that have recently taken place in Europe, and I have done so with very great care, as I know Colonel Clive and many of those I see here have done also,—as I read those narratives I confess I cannot find in any part of them any evidence that the introduction of breech-loading arms necessitates this system of strong companies, and when I remember what has taken place in those various conflicts as I read of them—I had not the advantage of seeing them—and try to evolve from my brain what I think would be the best system of organization for our own Army. I feel, I am bound to say, that the present system of our own organization appears to me to be infinitely preferable to that which has been advocated so ably by many here to-day, and notably by my friend, Colonel Clive. I believe, gentlemen, that not only would it be, as I think, impolitic and wrong to adopt the strong company system in our Army as the system of organization, but remembering the varied conditions under which we serve, and the varied composition of our Army, consisting as it does not only of regular troops, but of Militia and Volunteers in this country and in every colony all over the world; that it consists of West Indian troops and also of that large and magnificent army in India, raised from the

various fighting races, an army which I am glad to say is now disposable for service in all parts of the world ; when you remember this complex nature of our Army, and the varied material of which it is composed, I believe it would be not only unadvisable to adopt this four-company system, but even if that system were recognized as the best one, it would be utterly impossible and impracticable to do so.

I am much obliged to you for listening to what I have said. I have now only to add that I am sure you all agree with me in thanking Colonel Clive for his very valuable lecture, and also in thanking those gentlemen who have taken part in this discussion, and whose able speeches have added to the interest and the value of our proceedings to-day.

Evening Meeting.

Monday, 18th March, 1878.

REAR-ADMIRAL JASPER H. SELWYN in the Chair.

THE BEST METHOD OF CARRYING LIFE-SAVING APPARATUS ON BOARD OUR MEN-OF-WAR.

By Commander A. H. GILMORE, R.N.

THE subject of the paper which I am about to have the pleasure of reading to you, although embracing the vast issues of life and death, is, at the same time, so simple, that, whilst I hope to enlist your sympathies, I shall not trench long upon your time in reading it. The question affects directly those who go down to sea in what we are pleased to call ships; though what our ancestors would have designated them, I am at a loss to say. Well, these ships, although they, like the old men-at-arms, armed *cap-à-pie*, possess all the elements for destruction, also, like the men-at-arms unhorsed, are equally helpless when disabled, and are completely at the mercy of the light troops. Indeed, when not disabled they may receive a vital wound between the joints of their armour. In the prize-ring it was considered cowardly to hit below the belt, as the blow would be dangerous, and the pugilist dealing the blow lost the fight; in naval warfare the exact reverse is the case—the great aim and object is to strike below the belt and win the fight. A man struck below the belt could be carried out of the ring by his backers; a ship struck below the belt has but the resources of the ship for its crew to depend upon, for their safety. As I said before, the question touches immediately the crews of our ships; it also touches the relations and friends of these men and the country to which these trained men belong.

Although warfare has become so much more deadly of late years, our means of saving life are no greater (if so great) as they were some years ago. It was very rare in the old days of our wooden walls for a ship to go down in action, and I don't think there is a case on record of both combatants being sunk at the same time, the survivor was thus able to save the crew of its beaten foe; besides that, the floating *débris* was left for the men to cling to.

Very different are the conditions of warfare now-a-days; it will only be by possessing the greatest skill, seamanship, nerve and pluck (all of which I believe our seamen possess to a greater extent than the sailors of other nations), that a ship can hope to escape an action in which shot, ram, and torpedo are all brought into play, the injury

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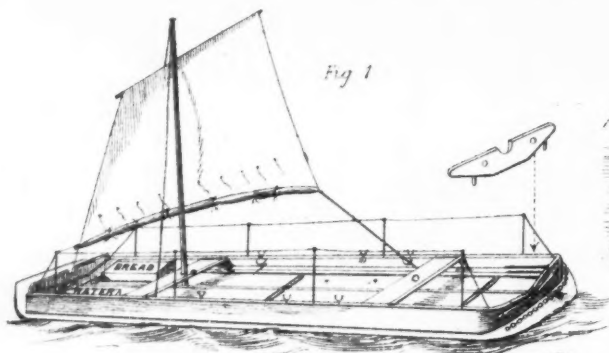


Fig. 1.

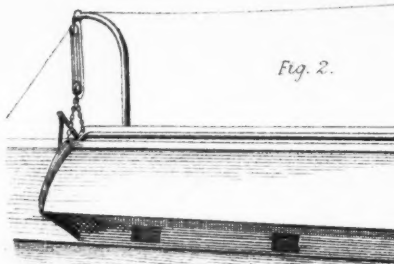


Fig. 2.

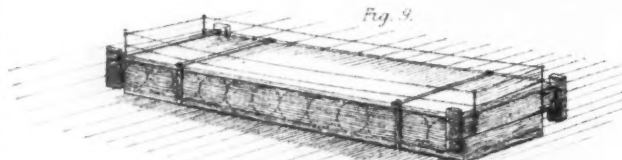


Fig. 9.

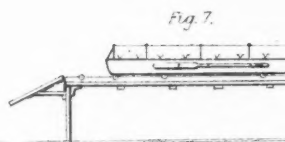


Fig. 7.

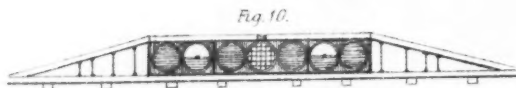


Fig. 10.

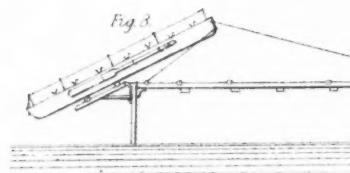


Fig. 8.

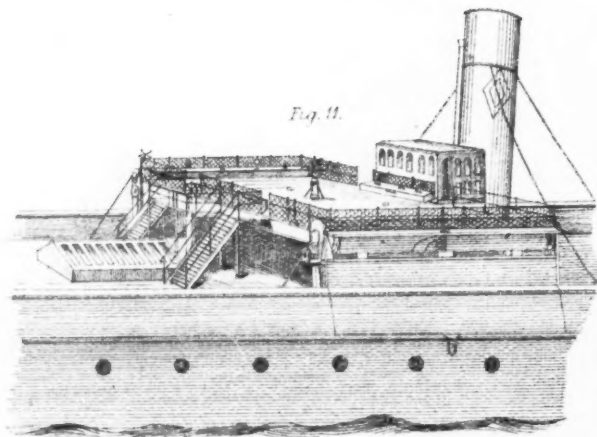


Fig. 11.

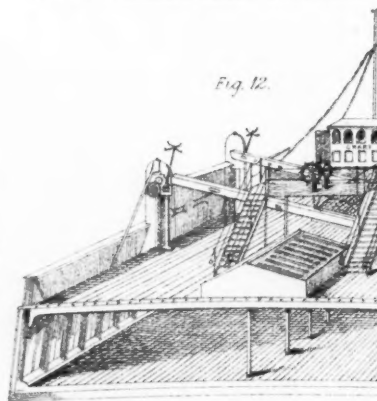
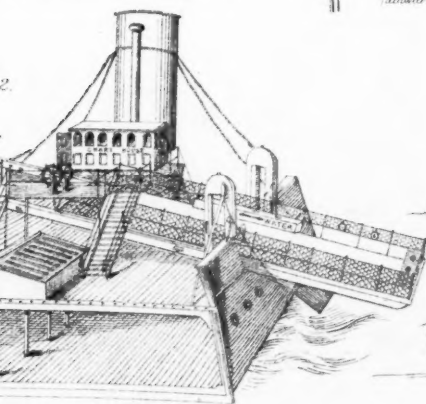
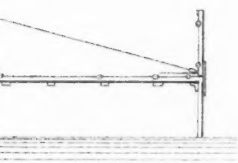
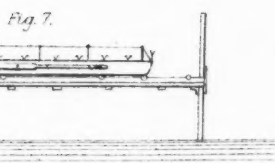
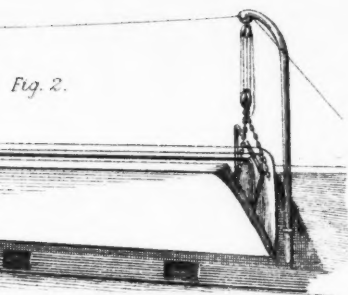


Fig. 12.

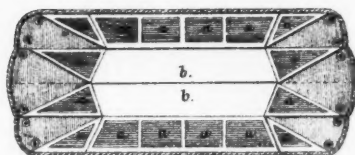
Raft shown in position as a Captains Bridge.

Raft in process of being launched.



being launched.

41. All. Cas. of pieces required



a a. a Cork. b b. Spanish Cane

Fig. 6.

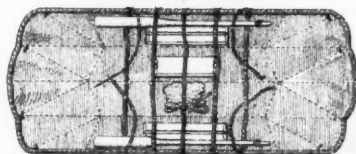
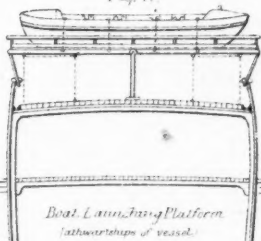


Fig. 5. By pulling the ropes the canoe is made as seen in Fig. 4.

Fig. 14.



Boat Launching Platform (athwartship of vessel)

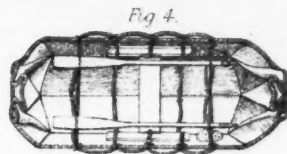


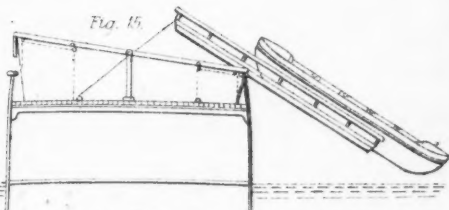
Fig. 4.



Midship section of Double Cylinder Boat with Air tubes.

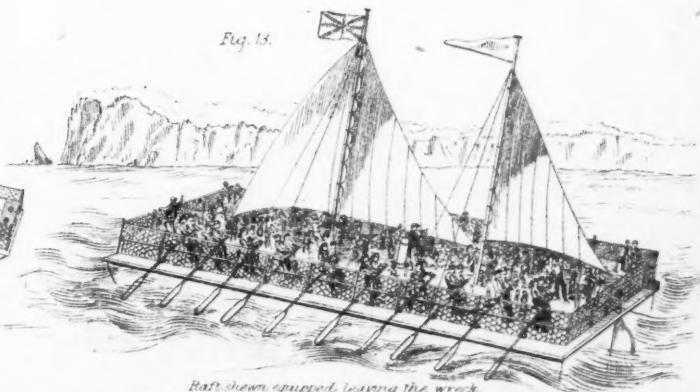


Midship section of Launching Platform or Boat carried on Pontoons.



Launching Platform discharging Boat into the Water.

Fig. 13.



Boat shown equipped leaving the wreck.

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inflicted by two of which might cause instant destruction. Of the two, I should prefer to be sunk by a ram, as it might remain to pick one up, although it is quite possible, that whilst effecting my destruction I might in the death-struggle give the ram its *coup de grâce*. Well, to save the crews of our vessels we have the usual ships' boats; but the larger of the boats will be lumbered up with engines and torpedo-gear, besides the chance that before the fatal moment came, when they would be wanted to save life, they may themselves have succumbed during the dangerous experiences which they are called upon to go through now, both at picket or on aggressive work as torpedo boats. Truth is, that the inventive mind has been so busy of late in devising the best (by best, one of course means the worst) and surest means of destroying life, that there has been no time nor energy left, to contrive how best to save life. How to burn, sink, and destroy has occupied too much time to allow leisure to look at the reverse of the picture. In our old paintings of sea fights, we see boats rowing about picking up the crews of sinking ships; in the Russo-Turkish war, however, in the few cases in which the Russians destroyed Turkish ships, the opposite has been the case; the Russians have been unable to save the Turkish crews. Of course the most strenuous efforts were made to save their enemies' lives, but, alas! without success! The fact remains, however, that the Turkish ships not being supplied with any ready means of saving life went down, and their crews went with them. What I propose, and what I wish discussed is, the best method of supplementing our boats with life-saving apparatus; I don't mean simply apparatus to support a man for an hour or two. Admiral Ryder and other gentlemen have suggested such means; but what I should like to see supplied to our ships is such equipment, in the shape of rafts,¹ as would suffice to carry their crews, and at the same time carry the necessary amount of subsistence to support the rescued men for a short time. We have read in history how hastily constructed rafts have been the means of carrying shipwrecked crews across large tracts of ocean, the men eventually being saved. We judge then what properly-constructed and well-supplied rafts might do on emergency.

I have examined the models of several of our ships to ascertain their capacity for carrying rafts without materially interfering with their efficiency. I find that the "Rupert" could carry a raft abaft the mainmast, and the "Wivern" rafts on poop, forecastle, and amidships. I would propose that vessels possessing poops and forecastles should have rafts on the top of them, constructed of air-tight cells or of cork-compartments, forming "flying" poops and forecastles. Vessels of the "Prince Consort" class could carry rafts in many places. "Achilles" and "Agin-court" the same; "Monarch" on the fore-castle, and from after-turret aft. The "Devastation" class could have the hurricane deck divided into rafts. The "Invincible" class can carry rafts upon the upper deck; in fact I don't think that there is one vessel in the Navy in which some place cannot be found available for the purpose. Our broadside ships might, also, carry boats, on

¹ The lecturer here showed a model of a raft (see Figs. 9 and 10), and also of another composed of mattresses attached by a framework of wood.

falling-out davits, similar to the paddle-box boats of old. I would also suggest that boats be supplied in frame which might easily supply the place of any that may be lost.

The only vessels carrying extra boats are the troopers, and they have Berthon's collapsable boats, which hang up like barn doors against the ship's sides, and which would speedily be riddled. As it is still contrary to the usages of war (strange as it may seem) to use explosive bullets, might not some arrangement be come to as to the employment of torpedoes, say—I know the idea is Quixotic—to limit their use to within a certain distance from the land? The people on board *St. Paul's* ship, on broken spars and fragments of the wreck, all got safe to land; but in this 19th century many of our ships don't carry spars, and as the fragments of the others would not float, it behoves us to have some part or parts of the wreck capable of floating. There is no doubt that our seamen and marines would go into action with the same pluck, energy and devotion as heretofore; but they would have more confidence if they knew that, if, through the fortunes of war their ship was to sink, they at any rate had a chance of being saved.

I must apologise for trespassing so long upon your time, but the question is a most important one, and I trust that the discussion this evening may be fruitful of good results. Of course the putting of rafts on the decks of ships and on their poops and forecastles would be rather cumbersome, and would add something to their top weight; but I defy anyone to spoil the beauty or add to the ugliness of our ironclads, and I should hope that our naval architects are capable of making such an arrangement of the weights as will allow of these superstructures being carried. As it is a question that comes more home to the seaman, and on which he is as well capable of judging as the ship-builder, it is to be hoped that our naval Officers will be consulted on the matter. Perhaps it is not too much to hope that the Lords of the Admiralty may appoint a Committee to inquire into the feasibility of our ships carrying either the life-saving gear I propose, or some better means for rescuing the crews of our ships.

The CHAIRMAN: I have now to invite discussion upon this subject, which is a very wide one, and likely to be a very interesting one. If gentlemen would only keep in mind that our ironclads are, as has been said, much more likely to hurt each other during an action, as we have seen in the case of the "*Vanguard*," than they ever were before, it will be seen how necessary it is to provide means for saving the lives of our men. We have provided many means of offence, but we have hitherto failed in providing any means of defence under water. . . This raft (Fig. 11) is a means at least of mitigating the enormous loss of human life which we might otherwise have to regret.

Commander GILMORE: I may state that Sir William Mends, at the head of the Transport Department, has a pontoon raft formed from the pontoons carried by large vessels, but it is not a ready means of safety. I think I may call upon Mr. Roper to explain his apparatus; it is a most ingenious invention.

Mr. ROPER: I was not under the impression that I should have to explain the raft to-night. This raft (Plate XVII, Figs. 11, 12, 13) takes up the position that an ordinary captain's bridge would occupy in a merchant ship. Instead of having a deck only for the captain to stand upon, I put a floating power under, on the cellular principle, either with a flat bottom, a corrugated bottom, or a round one, as shown in these models, subdivided into lengths as a protection against foundering. This does not in-

terfere with my floating power at all. The raft carries the necessary provisions, water, signals, stores, masts, compass, and everything that is required, all above water. In time of emergency the contrivances are so arranged that there is nothing to look for; there are no lashings to cut away, but the raft can be immediately launched. The weight of the raft is four tons; its length is 40 feet beam, 20 feet fore and aft, and it will take about 58 tons to sink it. The cost would not be more than 210*l.* or 250*l.* We come much lighter and much cheaper than ordinary boats. We have two rather strong forgings which keep the raft in its position, and by throwing down a lever we let go a tumbler, similar to letting go an anchor from a cathead. The raft would fall by its own weight, and you lower it down by any tackle or by any simple arrangement on either side of the ship. The system of launching Mr. White's boat is a plan of my own. It is Mr. White's boat, but it is my system of launching, given to Mr. White about fourteen years ago by Captain Hurst through myself.

The CHAIRMAN: The weight of the raft, you say, is 4 tons? What water would she draw?

Mr. ROPER: Seven inches light; and loaded it would take about 58 tons to sink it; it would carry about 400 men with the load on board; the draught is about 2 feet. It would leave about 1 foot freeboard. The cubical contents are 2,400 cubic feet, and the thickness of the material used one-sixteenth of an inch, steel or iron. A raft of this kind, fitted on a large man-of-war, of 60 feet beam, and 30 feet fore and aft, would carry something like 900 or 1,000 men. I have here a model of a raft, built on the corrugated principle, that will carry two 16-lb. field pieces and 12 horses, and about 150 men.

The CHAIRMAN: Is that model to scale?

Mr. ROPER: Yes; and it is built on the fluted-bottom system.

The CHAIRMAN: You trust to the fluted bottom largely for strength?

Mr. ROPER: Yes; and for a passenger ship, where she would not be likely to be picked up immediately, and you might have to navigate the raft, it would keep better to windward, either upon this principle or the tubular principle, than upon the flat-bottom system. The whole depth of the raft is 3 feet, but 3 or 4 inches additional, or perhaps 6 inches, could be added, or it might be made less than 3 feet deep, according to the size of the ship. My raft could be lowered on the deck of a war ship in action and shielded behind armour, and the cells could be filled with cork to stop rille bullets, which is a part of my patent, and if half the cells were destroyed, it would carry all the people that could get on it; the flying and ordinary decks of war ships also could be built upon my system.

Admiral RYDER: I should like, Mr. Chairman, to ask whether, considering the importance of the subject and the very short notice naval Officers have had, you would entertain the idea of continuing the discussion to-night under the understanding that there will be an adjourned discussion later in the season. If that was an understood thing it would shape the remarks of some Officers here who might like to wait until that adjourned discussion or might prefer to deliver themselves to-night. I ask you whether, considering the importance of the subject and the short notice that has been given, it would be possible to have an adjourned discussion.

The CHAIRMAN: That must be a question for the Council, it can scarcely be decided now. I shall feel it my duty to put the case before them as you have said. For the present I think we may go on with the discussion.

Admiral RYDER: The question is a very important one; as you stated, it is a very large question, and divides itself into many branches. Commander Gilmore has particularly devoted himself to one branch of it—viz., the *larger* question of the raft, which is a very important one in itself. Various descriptions of rafts have been proposed from time to time by different persons who have thought the subject well out, but besides that, there is the subject to which I have paid particular attention, namely, the *smaller* question as you may perhaps call it, but it is the one which has been thrust upon our notice during the last few years by two or three losses that we have experienced. One was the case of the "Bombay;" that ship was destroyed by fire, and when they came to muster all hands after she was burnt, they found nearly all the Marines and a large number of boys were drowned. Captain Wilson, now commanding the "Thunderer," was the commander of the "Bombay," and I

communicated with him on this subject years ago before I went to China; he gave me full permission to use his name, and I have no doubt he would do it now if I had had the opportunity of writing to him on the subject. His statement to me was this, that if the hammocks of the "Bombay" had been buoyant, no life need have been lost. That is a simple way of putting it. Just picture to yourself what it means. We all know as seamen where the hammocks are stowed in a ship; they are not down below, they are not secured, so that there is no difficulty in getting at them; they are in the nettings and perfectly handy, and though perhaps every man might not be able to get his own hammock, still if there are 400 men and 400 hammocks, it does not much matter whether a man gets his own or not, so long as the hammock itself is buoyant. Now picture to yourselves the loss of the "Vanguard." The weather is fine; she is run into by the "Iron Duke," and sank in little more than an hour. Fortunately, as I say, the weather was fine; fortunately the ship that ran into her stuck close to her, and the men were able to be saved in the ordinary way by boats. But if it had not been so, if there had been a sea running and she had sunk more quickly than she did, there would have been a great difficulty in getting the boats out, for there is much greater difficulty than there used to be in getting boats out that are stowed amidships, a fact which is familiar to all those who have been in our ironclads lately. Picture to yourselves the loss of life that might have been incurred owing to the absence of any means provided at present for saving the lives of the men if the boats cannot be got at. Buoyant hammocks in such a case would do this; they would not do a great deal for you, but they would do this, viz., enable the men to float in the water for perhaps a few hours—if there is much sea running, then for nothing like so long a time—but long enough to be picked up by any vessel in company with them. If that could be gained it would be a great point.

In future actions we shall have intentional collisions, and ships will sink in five or six minutes, as the "Re d'Italia" did in the action at Lissa, which sank in five minutes. There is no time to get out the boats in five minutes, but there is time for a man to fasten his hammock round him, and if the hammock is buoyant he will be floating. I hope the result of this discussion will be to press this matter on the attention of the authorities. If they like, let them have rafts fitted to ships, but at all events let us have such a simple measure as this taken of having the hammocks made buoyant. There are various ways of doing this, and it would be of course necessary to select the simplest and most economical as long as it is efficient. I investigated the matter rather closely some few years ago, and I began with it in this way. It struck me when I was second in command in the Channel Fleet, watching a particular evolution in which the two lines interlaced one with each other, and passed very close, what would happen if the man at the wheel let the helm go at a particular instant. Undoubtedly we should have had a collision; we were going at 8 knots; we should have struck one another at the rate of 16 knots, and should both have sunk, probably in ten minutes, and there would have been 1,200 men in the water. It occurred to me then that a *buoyant hammock* for each man was the only resource left to us. Commander Gilmore was pleased to say that I was the inventor of the cork mattress. I do not know that I am the inventor of anything. The cork mattress has been long known. It is used on certain lines of packets, and in America constantly. All that I had to do with it was to press upon the attention of the Admiralty the importance of making hammocks buoyant, and I suggested to their Lordships to have cork mattresses. Their Lordships allowed the Captain of the "Valorous" to try some experiments. The first thing was to make the mattress *buoyant*, and then *comfortable* for the men, for Jack likes a fairly soft mattress to lie upon; he will not put up with what the Russian is well contented with, viz., a very loose bag of ticking, in which the cork slips about from one end to the other. Our men are not content with that, and therefore the mattress had to be prepared with internal partitions to prevent the cork from slipping about. The men said they were still not comfortable enough, the mattresses were rather hard; and although the pieces of cork were very small they were not comfortable, therefore it was found necessary to put some hair on the upper part of the mattress. Of course that ran up the expense of the mattress to a certain extent. But the question reached this point, viz., that the Admiralty four years ago gave directions that 1,000

of these mattresses should be made, and that an experiment on a much larger scale should be entered upon; unfortunately, a change took place at the Admiralty, and a counter-order was given. The cork mattress was exposed to this test—I am not saying it was an improper test, but at any rate it was a peculiar one. It was ordered that a cork mattress with hair should be sunk six feet under salt water for 24 hours, to see what would happen to it. Of course it never entered my mind that it would be necessary to sink it in that way, therefore it was not an experiment I should have proposed myself. It was ordered, however, by proper authority, and tried, and then the mattress was hung up for 21 days, and a log was kept of its proceedings during that time, which were these: The weather was alternately damp and dry, and the mattress indicated different weights on different days, varying some few pounds and ounces, and at the end of the 21 days it was not dry. I do not know whether any of the gentlemen present have noticed that their sponge is not dry when it comes out of the sponge-bag in which they may have placed it, if the orifice is closed; and for the same reason it is not natural that cork should dry if left in so thick a cover as the tick of a mattress. Owing to its having been immersed in salt water it behaved very like a monkey jacket at sea after it has had a thorough drenching—it is heavier one morning than it is on another, because the salt absorbs the moisture one day and then when the day is dry the jacket becomes lighter. However, this was considered sufficient to condemn the cork mattresses, because it was supposed it would be highly inconvenient if they behaved in that way. That being the case I turned my attention to a waterproof cover for the mattress, or a waterproof sheet. It occurred to me if their Lordships would not have a cork mattress, the next best thing was to place a waterproof sheet 8 feet by 4 between the hammock and the mattress; the sheet being lashed up inside, would oppose a great deal of difficulty in the way of the hammock sinking. I tried the experiment to satisfy myself about it in this way. The hammock with the sheet in it was lashed up, and I placed it in a tank with the weight of a man under water attached to it, viz., 20 lbs., and after 48 hours I found it had not sunk, nor had the water forced its way through in any degree. Of course, in the open sea among the waves, the floating body would not be in quite so favourable a condition as it was in a tank. If the foolish man who is attached to the hammock, and wants to be sustained by it, climbs over it and forces it under water to some distance, the water may find its way ultimately in amongst the hair of the bed, and the hammock would sink. No doubt those of us who have been at sea have seen how hammocks fall overboard and float until they are lost in the distance if they are not picked up, but if there is nothing impervious in the hammock the water will gradually force its way into the hair and the hammock will ultimately sink. I know, however, by the experiments I have tried, that a waterproof sheet of sufficient size interposed between the hammock and the mattress will just enable the hammock to keep one man floating for a few hours. After that I do not think many men floating in a rough sea would have much chance of living with their bodies immersed in the water. I believe these sheets can be made of stout, strong calico for about four shillings a piece wholesale, but cheaper in the dockyards.

Captain P. H. COLOMB, R.N.: It seems to me in these matters you have first to think of general convenience. Humanity is constructed of that stuff that it will not submit to a permanent inconvenience, however good the ultimate result may be. If you propose to supply life-saving apparatus to a ship, to come into special use when that ship is sinking, you must consult the convenience of the people on board that ship, and the convenience of the purposes for which the ship is constructed. Now I own that between the question of rafts as supplied to men-of-war, and the question of an arrangement for making the hammocks buoyant, there seems to me to be a very distinct line of demarcation. It is quite certain that making the hammocks buoyant, say, by means of a waterproof sheet, is no sort of inconvenience to anybody, but, as Admiral Ryder has just pointed out, it is a very great convenience to the crews of our ships. On the other hand, it seems to me always difficult to place anything on the raft principle in such a position and under such arrangement on board our war ships as shall not cause very considerable inconvenience. The weight carried by ships of war is cut so exceedingly fine, and the position of those weights is so very accurately distributed, that even a matter of

four or five tons carried at a height above the deck, would be a consideration which would to some extent embarrass the naval architects. But on the other hand the weight involved in making the hammocks buoyant is of course not to be considered for a moment. Neither is the expense. And, speaking from the man-of-war point of view, what we really do look for is immediate safety, not that we should be able to make a voyage on a life raft after the ship is sunk, but that we should, when the ship sank under our feet, be able to save ourselves, float ourselves for the five minutes, the ten minutes, the hour, or the two or three hours that would elapse in an action before steps were taken to pick us up. There again it seems to me that the buoyant hammock is the proper plan. I have thought for some years more or less on the subject, and I find I always reverted to the buoyant hammock as being the most easily arranged and the most useful for the purposes of the war ship. For the merchant ship we have not the hammock, and there I fancy that the arrangement of the life raft comes nearer to the ideal of what would be required. There indeed the crew cannot depend upon being picked up in a matter of minutes or hours; there indeed it is necessary for them to have the means of maintaining themselves afloat for perhaps days, or it may be weeks, and therefore I think that for the merchant ship the life-raft principle is one to be aimed at, while for the man-of-war I think that the buoyant hammock is the object of our desires. But the lecturer reverted to a point which I hope may be taken into consideration, if it is adjourned to a future occasion, that is, to the question whether the modern system of warfare which strikes a man "below the belt" is a fair system. I cannot help observing here and there in different quarters, a feeling growing up that the employment of arrangements for sinking and destroying ships is after all very similar to the arrangement for using explosive bullets. In former days you made an attack upon a ship in her port, you boarded her, "cut her out," and you brought away a prize without injuring human life more than was absolutely necessary to take possession of the ship. Now, on a dark night, with disguised language, and disguised dresses, you sneak out alongside the war ship. You pretend to be that which you are not, and you explode certain kegs of powder under her bottom, and you send her and all on board to the bottom; and then you think you have done an exceedingly valiant action. I own that I hope the time will soon arrive when some international arrangement may be come to limiting the use of weapons which destroy life without gaining anything like commensurate advantages, for I am quite certain the combatant who goes in, cuts the ship out, takes her away and maintains possession of her, does very much more for the country he serves than that combatant who goes and simply sinks her and destroys the lives of those on board.

Admiral R. V. HAMILTON: I was in hopes we might have heard some one in the Merchant Service speak on this subject, for it is certainly one of great importance to them. For my own part I must say I quite agree with the lecturer on the main subject which he has brought before us, however I differ from him on one or two points. And first in his attack upon the beauty of our ironclads, for that is a point upon which, having commanded the "Achilles" for three years, I differ, having always thought her a very handsome ship; to revert to the main point, however, she carried 700 men, and her boats only held 250, therefore it is very certain that those boats ought to have been supplemented by something in the way of rafts. No doubt ships ought to have some additional means of saving life, and so far as I have heard, I certainly agree with the hammock system as being almost the only one applicable for men-of-war. There is also another advantage resulting from the use of the waterproof sheet, for we all know the unpleasant result of having a hammock saturated with salt water, so that being covered with this waterproof sheet, the comfort of the men would be greatly increased, as the bedding could not be wet. All the Cunard steamers carry life-buoys according to the number of passengers. On one occasion I remember the "Africa" getting ashore on the coast of Newfoundland, and they were afraid she would go down, and such was the excellent organization on the ship, that every passenger had his life-buoy. There was one man in such a state of panic, that he put his life-buoy on feet foremost, so that if he had gone overboard, he would simply have floated head downwards. It is only by good organization in the hour of safety that you can meet the demands of the time of sudden emergency. I have seen two

wrecks in my life; I never wish to see another. In the one case the ship went to pieces in five minutes, and every soul was drowned. The other case was near Portland in the month of November. A large ship came on shore at half-past five in the evening; it was pitch dark, and blowing a heavy gale, but owing to the organization of the Coastguard, and the way the rockets were got on board, by half-past seven that evening 62 lives were saved, owing also to our having by great good luck a very large supply of blue lights and tar barrels on shore.

Admiral RYDER: Commander Gilmore spoke of making a raft of mattresses. The cork mattress will only float 60 lbs. weight, that is, three men in the water with their shoulders just awash. By his raft of mattresses to support the whole crew he of course means to have the men *on* the mattresses, so that taking a small man to weigh, say, 120 lbs., it would require two mattresses to support him out of the water, although one mattress will support three men in the water—this has often been overlooked. Rafts of mattresses would be out of the question if there is only one mattress to each man.

Rev. JOHN GILMORE: Although a clergyman, I was during a long period in a position which gave me a special interest in the question of life-saving at sea. For many years I was stationed at Ramsgate, and was very much interested in the life-boat work that went on in that port, and have thought much and long and patiently over the various considerations suggested by that most important question of life-saving at sea. With reference to the subject of the lecture, I cannot help thinking that we are, as a nation, very apt to be content to live in a "Fool's Paradise," to forget some part of our duty, to ignore some evident danger, and we require to be aroused from our apathy by some great and sudden calamity,¹ and then alone do we realise how foolish we have been to have remained in such circumstances so long. Every imaginable appliance that ingenuity can suggest or money provide, has been suggested and provided for the sake of the destruction of our enemies, but what means have we taken in proportion with reference to the saving of our friends? Undoubtedly we must feel that as we hope our extensive armaments are sufficient to destroy the ships and lives of opposing foes, so we must not forget that the armaments of those opposing foes are also sufficient to sink our ships, and to destroy the lives of our friends. In this possibility have we attempted any large organization to meet such a contingency? We must say, we have not. I cannot but conceive that both the suggestions made by the lecturer and by Admiral Ryder are essentially necessary. We shall require means for ensuring safety for the individual during moments of immersion, and also means for the safety of the many during a possible long period of exposure in the sea. It seems, perhaps, almost impertinence on my part to suggest it, but I think if this waterproof sheet as shown us were supplemented by a purse at either end, into which the ends of the hammock could be inserted, it would enable the hammock to be wrapped up much more easily, and so protect it from the water, and it would also have its uses on shore. I think the suggestions made by Admiral Ryder are very valuable. I was very much interested some years ago when my attention was first drawn to the raft suggested by Mr. Roper; really one almost feels inclined to think that the great reason why all these means of life-saving have not long since been provided, is this fact, that a man can only be drowned once; and sailors are tempted as it were to take their chance of this once. If it were possible for a man to be drowned some twelve times, after the tenth time or so he might perhaps become urgent for the providing of some means of safety in the case of fresh danger for saving himself. But, seriously, it is not the sailors, who run the risk of being drowned, who have the organization of these matters on shore. We on shore should see to it that twelve men shall not be drowned if we can help it, although one man cannot be drowned twelve times. Speaking as one associated with the sea and seafaring men all my lifetime, and expressing the spirit and feeling of, I most fully believe, the country at large in its love for the Navy and sailors, I do believe any amount of reasonable or even unreasonable expenditure would be popular with the nation, that would give people

¹ Since this discussion took place, the dreadful loss of life by the foundering of the "Princess Alice" on the Thames has occurred. It is to be hoped that *public* attention will now be fully given to this most important question.—Ed.

the idea that our fleets are provided with that machinery which shall be the cause of safety in the possible contingency of a ship being struck by a torpedo, or by the huge shots that are now prepared to be fired at them. Mr. Roper's raft is in all its ingenuity absolutely a ship in itself—an empire within an empire. It is easy of construction, and although an objection has been suggested as to the top-hamper of its weight on deck, yet true philosophy knows this well and always seeks to act upon it, namely, that in almost all cases in life, there is no such thing as a perfect good. We have to weigh possible evil against possible good, and I cannot help thinking, considering the immense weight of our vessels, that the centre of gravity would not be elevated to a very disproportionate extent by a top-hamper of four or five tons, and that that could not be a strong argument against the expediency of some such plan as that which Mr. Roper proposes. I imagine the lecturer has suggested his own raft as a modification of that plan, where the bridge-raft of Mr. Roper cannot be accepted, and as something to place at any part of the ship on account of its greater simplicity. With reference to the hammock and waterproof sheet scheme, I would ask why should not it at all events be carried out? Supposing we had to have the horsehair mattress instead of the cork, the hair mattress in the hammock would itself have an immense power of buoyancy. If the water were kept away, it would be nearly as efficient as the cork, and by means of this waterproof sheeting the water can be kept out. I must apologise for obtruding my opinions upon this meeting, but the deep interest I take in everything connected with our seamen must be held as my excuse.

Captain LINDESEY BRINE, R.N.: In lieu of a raft of this description (Roper's) I think that it would be more useful to try a system which would answer two or three purposes; and I would ask why should not the bridge on board most vessels of war be so fitted as under certain conditions to be able to be used as an ordinary boat for landing or embarking troops, or for the ship's own purposes. It seems to me that this plan of Mr. Roper's is more fitted for merchant ships. If the weight is an objection, there is no reason why it should not be made half the size; and it will then still be able to carry a large number of men. I should like to ask what objection, beyond that stated by Admiral Ryder, has been made to the principle of the waterproof hammock? No doubt the lecturer's attention has been turned to all these points, and perhaps he can give us some information.

Commander GURDON: I should like to ask one question. Has Commander Gilmore considered what will be the effect of artillery fire upon these rafts? At the present day you find that your boats are absolutely riddled in five minutes. In the action between the "Shah" and the "Huascar," the Peruvian ram's boats and all her rigging were cut to pieces in five minutes. Have you calculated the effect of artillery fire on the rafts?¹

The CHAIRMAN: The shortness of the notice has prevented the presence of many who take an interest in this subject; but before we close I should like, in a few words, to strengthen what has been said rather than to criticise. There are, indubitably, at present objections to the carrying of any more very heavy weights above, in a man-of-war. When you come to understand that some of our finest ships have a margin of safety which might be reduced to 17 degrees of heel and is at best ranging between 30 and 40, and that these proposed additional heavy weights are at the extremity of the lever, if carried so high up, one can easily see why for men-of-war as at present designed, the question of carrying more weights highly placed, is one which naval architects watch with the most jealous care. I hope to see turrets abandoned sooner or later in favour of guns carried lower down, and then possibly we may attend more to the life-saving question; but at present we can scarcely do it

¹ I fear that the concussion from the heavy guns carried in turret ships is so great, that any raft or boats carried, as Commander Gilmore proposes, would be speedily rendered unseaworthy; and in sparred vessels it is *absolutely necessary* to keep the decks clear to work the ropes and spars. The only solution of the difficulty that I see, is to carry boats of prepared canvas in frame, that would fold up like a crinoline, taking up no room, with rowlocks of wood fitted in, shoes of wood at stem and stern ready to fit in stem and stern posts, and a fitted kelson of wood in sections.—T.P.G.

in this manner. In a naval action, just at the time when it might be hoped that contrivances such as those brought before us could contribute most to the saving of life, it would be found that they were extremely open to any mitraille or shell fire and probably would be rendered useless long before the ship herself was sunk. But with regard to our passenger steamers, few people understand what is the discrepancy between the requirements of the Board of Trade and actual practice. I have been across the Atlantic several times in 6,000-ton vessels, carrying actually from 1,500 to 2,000 passengers, capable of carrying with ease 3,000 passengers. There were probably boats on board, in case anything happened to the ship, which would have carried from 200 to 300 passengers, supposing all those boats had been got into the water without damage (which is a thing you can scarcely expect from an undisciplined crew and still less disciplined passengers), and supposing that every precaution had been taken. Is it not then time for the British public, which travels so much by sea, to turn its eyes to the possibility of making the very unsightly structures which compose the upper decks and bridges of modern large steamships available for a purpose so useful as that of this raft? In order that this should be done, a great many persons have devised different species of rafts to be put together in case of necessity. I need not say that the bridge-raft supersedes all these in its immediate applicability,—that it is capable of carrying provisions and water, and many other things which must not be wetted. It may indeed be used as a bridge; but it is fitted really for the purpose of life-saving, and is in a place where it can easily be got at if the ship should go down even very suddenly. It has in principle great advantages for that purpose, and I hope to see it closely studied and very largely adopted. As to our men-of-war we must take our service in the Navy with the understanding that a great many more risks are to be run by everybody embarking on board the man-of-war than was formerly the case. We are quite content to run those risks, and we ask for nothing else in the Navy, but to be allowed to make them (what the naval architect does not always make them)—seaworthy; to make them capable of being fought with the least possible risk, which the naval architect does not always understand; and to make, also, a possibility of saving as much life as possible when the ship herself is destroyed. Those are the conditions we ask to be allowed to fulfil; and when naval Officers of high rank come forward with ideas such as these of buoyant hammocks, or any other form by which life may be saved, and certain disabilities may be met by seamen, I think it should receive not only the appreciation of the authorities, but also the appreciation of the British public. Unless the nation demand that their seamen shall be protected, it is hopeless to expect that the subject will be attended to. So soon as the British public takes a question up, it is attended to in the House of Commons, and the House of Commons makes it necessary for the authorities to attend to it closely also. The spirit of resistance to the introduction of new inventions is not an unnatural one. It arises simply from the fact that no man in the position of a high official can possibly attend to these things, and the British public can only do good by inducing the formation of scientific bodies of men to whom the authorities can go with confidence for the appreciation they have not themselves the time to give. An Institution such as this does a great deal of good in this way. It brings together a great number of conflicting opinions; it gives everybody an opportunity, whether a civilian or a professional man, of having his ideas discussed; and we hope it may be of increasing utility to the public services in that way. I should be glad to see more attention paid by professional men to these lectures; but when you ask a man, after eight or nine hours of office work to come here and sacrifice his evening, you ask him for a great deal more than most men are willing to give. With regard to what has been said about the double use of the waterproof sheet, no more fatal enemy has ever been met by the British soldier or sailor than disease. The bullet does not kill in any war, one-tenth of the number of those who are killed by disease. It has been found that sleeping at night on the ground is productive of the beginning of almost all those diseases; and if by having this arrangement for the hammocks at sea you can save life in the case of disaster, and provide not only for our sailors, but also for their comrades in the army who are disembarked in larger numbers, a protection against the seeds of disease on shore, and so prevent a diminution of the lamentably small number which we reckon as our

active forces, we shall have done a great thing for the public service. No words of mine can overrate the importance of the attention which must be given to this subject, whether it be in the shape of hammocks for men-of-war, or rafts for our merchant steamers. We have arrived at a time in the history of the world in which many go to and fro, and knowledge of these points certainly ought to be correspondingly increased.

Commander GILMORE: I am much obliged to you for your kind attention. I call my paper particularly "The best method of carrying Life-Saving Apparatus on board our Men-of-War." Of course anything that would tend to save life on board a man-of-war would equally tend to save life on board a merchant ship. Admiral Ryder alluded to the difficulty of getting out boats in these very long ships. A vessel has to get her boat out by tackle from mast to mast, 150 feet distant, and the strain on the tackle is very great. My proposition obviates that: I also propose that the beam boats shall come down under cover, and be protected. There would be no difficulty in putting on tackles; the tackle can always be hooked on, and the boats ready for being turned out. The question of the constructor not being able to add a few pounds to the upper deck of our large ships seems rather a curious one. The difference of the weight of one iron plate would make all the allowance necessary for Mr. Roper's raft, and you might taper some of the iron plates off or remove one if there was any necessity, and so make allowance for the increased weight. My raft, as Captain Colomb said, is a supplementary one to Mr. Roper's. It was not intended to be carried on the bridge, but in such parts about the ship's deck as may be found convenient. This raft would lie between two skylights and the bulwark; it would be plated so as to protect it from mitraille, and the cylinders would be packed with cork, which if perforated would not seriously injure the structure. (Figs. 7, 9, 10.)

There cannot be the least doubt in the world as to the great value of the hammock as proposed by Admiral Ryder. It is very well for a man to float about for two or three hours if there is a chance of being rescued at the end of that time, but in the case of a naval action, it would very likely be the case of Kilkenny cats over again, and no friends or enemies might be left to pick them up, and it would be almost charitable to let him put his hands above his head and go down at once rather than for him to be floating about for two or three hours with the certainty of sinking at the end. The raft must come into play if you want to save many men. If a vessel is at hand to pick up the men, well and good, if not, you can at very small expense and without very great inconvenience, have the means of saving your crews.

Mr. White's boats are something on the principle of Mr. Roper's, who told you that he was the introducer of the principle to Mr. White. Mr. White's boats are on the bridge and are launched from the bridge, but they have no other advantage over any ordinary boats. In the case of a merchant vessel, even if it had all the possible boats, the rush of passengers in nearly every case causes the loss of several of them; but it is impossible, however much they rush on to a raft, to sink it or capsize it. The raft cannot be capsized by any action of the waves; it would be driven by the waves along the surface of the water without any chance of being turned over.

Mr. ROPER: With regard to lowering the raft, my raft can be lowered down within the iron plating on to the deck, and elevated again for launching, or it can be lowered on deck and launched as the ship rolls. About the top-hamper, I think we should come much lighter and much cheaper if you would dispense with half the boats. If you were to adopt the hammock principle you would come much heavier.

Commander GILMORE: Hammocks must be carried.

Mr. ROPER: But then the waterproof sheeting, and the cork for 400 hammocks, would come to five tons.

Admiral RYDER: I was not speaking of cork, I proposed the sheeting, which weighs 4 lbs., or 500 will weigh 2,000 lbs.

Mr. ROPER: But your sheet won't float you.

Admiral RYDER: The mattress in a waterproof bag, or in a sheet, and so long as it remains impervious, will float six men.

Mr. ROPER: A cork mattress?

Admiral RYDER: No, no cork at all, a hair mattress; the buoyancy of a hair mattress, if made impervious to water, is over 120 lbs., which will float six men with their heads and shoulders out of the water, but the indestructible buoyancy of cork is the only reliable buoyancy.

Mr. ROPER: My raft, to carry 400 men, weighs scarcely 4 tons. Had the "North-fleet" had a raft of that kind, with a raised cabin in the centre, holding from 150 to 200 women and children, all would have been saved, and where you have a poop and forecastle to your vessels, you could have an extension of those decks on the raft principle; they would carry all the people on board, and come very much lighter than the boats.

The CHAIRMAN: It only remains that I should propose a vote of thanks to the lecturer for the paper which he has read to us. I am sure the meeting will have great pleasure in complying with that, and also in thanking Mr. Roper for his explanations.

Monday Evening, 6th May, 1878.

ADJOURNED DISCUSSION.

REAR-ADMIRAL JASPER H. SELWYN in the Chair.

Admiral RYDER, who had moved the adjournment, having preferred to defer his further remarks to a later hour of the evening,

Señor DE LA SALA said: I had not the pleasure of hearing the interesting paper of Commander Gilmore in March last, on the subject of "Life-Saving Apparatus for Men-of-War," but on reading a report of it in the newspapers, I was much struck with some of his views, and also with those of other gentlemen present on the occasion, because they touch very closely upon some ideas of my own on the same subject, consequently I had the honour of bringing them under the notice of Admiral Selwyn. It seems to me an abnormal state of things that the minds of men should be mainly directed to the study of the most effective means of destroying life, leaving untouched, or but little thought of, the far more noble and important question of the *saving of life*. England possesses the finest fleet in the world, and, considering the cost of her modern men-of-war, it is but right that every means should be taken to ensure their safety. England also possesses the finest and most daring seamen, or, as the First Lord of the Admiralty said two days ago at the Royal Academy Banquet, "the most magnificent of crews;" surely, then, on the principle of thoroughness and logical consistency, no expense should be spared—no means left untried of protecting their lives from the many dangers to which they are exposed. It has now come to be generally understood that something must be done in the way of producing more effective life-saving apparatus than is at present in use. In the production of this, some important considerations are involved, chief of which are, cost, bulk, capacity, and readiness for use. Keeping these in mind I have endeavoured to construct something which I believe embraces these four points. In the small models which I shall presently have the honour to submit for your inspection, you will see the principle upon which, what I would call folding raft-boats, are constructed (see Figs. 3, 4, 5). This is a combination of thin strips and boards of pine and cork, covered by waterproof canvas, and arranged in such a manner that from their folded and flat condition they can, by a simple handling of cords, be pulled into the form of a boat ready for use. Another advantage is, that it is not necessary to pull the structure into the shape of a boat before dropping it into the water, for it can be thrown into the sea in its folded condition, and there pulled and turned into a boat by any one who can swim. Being adapted either for folding or to remain flat, it is thereby a great economizer of space—a very important consi-

deration, as it enables a ship to carry a large number of them without causing obstruction or inconvenience. In fact, they could be packed and placed in any available place on board. Constructed on the most elementary of plans, and of the most simple materials, the cost of this description of lifeboat would be trifling compared with that of all kinds of boats constructed at the present time. With the necessary materials at hand—which are always to be found on board of any vessel—the time required to make a folding raft-boat would be comparatively short. Further, it requires no very extensive knowledge of boat-building to “turn one out.” With a little practice any one could make his own lifeboat, all of which is an advantage in the way of economy and resource. They can be made of any size, but for prompt, life-saving purposes, perhaps folding-rafts of the dimensions of an extended hammock—and serving also as a hammock for the sailor—would be the most serviceable kind of small life-canoe. However, the question of size need not be fixed. If we can get what we want to keep men afloat and *above water*, it can afterwards be determined what size is the most convenient and useful. Means, such as the life-belt, buoy, or floating hammock to keep men afloat, are better than nothing at all, though immersion of half or two-thirds of their bodies is not always pleasant, especially if it be for a lengthened period, or even a few hours. Now, a contrivance that enables a man to keep afloat and *out of the water* protects him from the imminent dangers of death to be encountered in all seas. Raft-boats on a large scale must be made of materials possessing good floating qualities. Cork is a good buoyant substance, but wood can be made more buoyant than cork, and cork itself made still more buoyant, and at the same time stronger, by the system of tubular cells inside the boards (Fig. 6). I present you with various samples of what I may be allowed to call the tube-insertion or tube-joining system. The wood, you will observe, is tightly joined together by tubes which, over a given space, give to it a large proportion of buoyant power, without impairing the required resistance of the material. It is therefore manifest that boats built on this plan acquire very great powers of flotation. In fact, it will be evident to you that this system could be advantageously applied in many other constructions. If the whole *dead work* of a vessel were made on this system, a *life work* would be at hand in case of need. Cabin-doors, tables, and every possible bit of furniture would float like pieces of cork. One of the chief considerations to be borne in mind is that in securing these advantages there is no additional cost, but on the contrary perhaps a saving, owing to the economy in material, and by the aid of proper machinery to execute the work, small pieces of wood could be utilized to make light and very strong boards of any required length or width.

The CHAIRMAN: What weight will the hammock carry?

Señor DE LA SALA: It is only intended for one man.

(Models of rafts and boats constructed on this principle were exhibited by Señor de la Sala; also specimens of pine boards and cork planks treated on the tube-joining principle, by which it was shown that a pine plank thus treated was in its specific gravity .064 lighter than a solid cork plank, and cork was reduced 33 per cent. of its specific gravity by the same process.)

Commander CURTIS: I should like to make a few remarks with respect to the models that Señor de la Sala has shown us. I saw Miss Beekwith swimming at the Westminster Baths, and also Captain Webb, who, as you know, swam across the Channel, swimming at Cheltenham in the ornamental water in Montpelier Gardens. He had an invention consisting of waterproof canvas, with wooden sides, and the way he got upon that apparatus was by half-hauling it under him, and so clambering up like a seal to the end part of his raft. Miss Beekwith tried to get on to the raft, but was not able to do so. That raft was made of boards, 8 feet square. There were no barrels under it, and she could not get on until her father held the other end, there being no stability in the raft. The same thing will apply to what the Señor has brought before us. His raft is very good, provided you can get into it. It, however has no stability in itself, and a person in the water would have to haul it under him in order to get into it. I scarcely see how any one is to get into that boat, unless one person gets in on one side and another on the other, as we see the natives do with their canvas rafts on the coasts of Africa.

Señor DE LA SALA: There are several Spanish steamers in which these boat-rafts

are used. I shall be most happy to invite you to Millwall Docks any day to see it tried on the "Cervantes" and other Spanish steamers. They have been tried on a larger scale. Of course it is not so easy for a man to get into one of these boats when it is in the water, but as the floating power is so great, the boat will be always out of water.

Commander CURTIS: Would you launch the men in the boats?

SEÑOR DE LA SALA: They may be launched in the boats if they like, but if they are in the sea, they have to get themselves in. They can keep themselves upon the boat because the boat will not sink.

Commander CURTIS: If two or three men tried to get in on one side, the boat would turn over upon them.

SEÑOR DE LA SALA: You can satisfy yourself as to the practicability any day you like.

The CHAIRMAN: If no other gentleman rises on this particular part of the subject, I think the meeting will allow me to say that Señor de la Sala has at least shown us a very new way of using wood and canvas, and his models show great ingenuity and deserve great attention, although there may be some little difficulties as to how a man shall get into them when they are in the water. As long as there is the floating object there, I think drowning men will scarcely fail to catch at such very good straws as these.

Mr. EDMUND THOMPSON: Since coming into the room a paper has been put into my hand from the Society for the Encouragement of Arts, Manufacture, and Commerce, on the question of "Saving Life at Sea." A gold medal is promised, but one very important point is that neither boats nor rafts will be admitted to the competition, on the ground that it is almost clear that in the contemplated cases of abandonment, neither of them could be lowered or cleared away in time, and because even if boats stowed outside could be cleared away, there would not be really sufficient space to provide means of safety for all the crew and passengers. That is exactly what I am going to show you to-night is possible to accomplish. I have been many years interesting myself in the question of saving life at sea, and I hope to show you that it is absolutely necessary, and that it is both simple and possible to carry boats and appliances in the way of rafts to save *everybody* on board. In looking at the Board of Trade returns, I find that during the last ten years no less than 30,000 lives have been lost by accidents by shipwreck on our coasts or in British shipping abroad; and if we just look at two or three cases, such as those of H.M.S. "Captain," the "Cospatrick," and the "Birkenhead" (of olden times), which I very well remember, and to the more unfortunate one of H.M.S. "Eurydice" the other day, we find all these instances show that what we want is a certain instantaneous mode of getting effective boats and rafts, not merely makeshifts, into the sea. What we do want is a good boat and a good raft which has good oars, sails, and all other appliances for going on a voyage, and also provisions and water for the maintenance of its passengers for a given number of days. I think if I can prove to you that this is possible, I shall then have satisfied you that in point of fact what the Society wants, and what the world wants, is practicable; and that people need not go to sea in ships and be under an uncomfortable feeling that there is only means provided (even if the boats can be got overboard, which very seldom happens) for the safety of a mere portion of the crew. I have been connected for many years with the emigration trade, and also with troop-ships during the Crimean War, when we had to fit out some steamers for carrying troops to the Crimea. What has always struck me painfully was that, do what we could with all our appliances, the number of boats was most inadequate, and the mode of getting them overboard was still more so. I have unfortunately had two melancholy experiences during a long course of loading and owning vessels, and they both occurred with the same ship. In the first case when with 500 passengers on board, bound for New York, the vessel, being improperly ballasted, and having her weight too much below, lost her masts and was brought back a derelict. This vessel, on a subsequent voyage, while chartered by Her Majesty's Emigration Commissioners, and certainly with as fine a crew (with passengers 500 souls) and appliances as perfect as then possible, was never heard of again. These two circumstances made me determine to devote my time and my money (for unfortunately I have devoted a great deal more money

than I should have done) to the devising of means by which these accidents could be prevented in whole or in part. I lay down the propositions—first, that boats shall be so constructed that they shall be practically unsinkable; secondly, that they shall have enough accommodation for stores and water for a reasonable time, say twenty days, for everybody; thirdly (and I will include rafts as well as boats), that every vessel shall be compelled to carry a sufficiency of these rafts and boats to save every soul on board; and, fourthly, that an arrangement shall be made, by which these boats can be put into the water in an instant of time. I do not want five minutes; I want only comparatively an instant of time that, even with everybody on board, but at all events the boats themselves may be instantly placed in the water; my theory being first to get your means of safety into the water (whether with or without your passengers), and the chances are the passengers may, and most probably will, by appliances which I should certainly recommend to be carried—such as cork life-saving apparatus, and that sort of thing—be able to get into the boats. Some three years ago I made some experiments at Blackwall, when Admiral Sir Alexander Milne, the late First Lord of the Admiralty, Lord Gilford, Admiral Sir William Mends, and other gentlemen were present, but my experiments were unfortunately clouded by one catastrophe—the boat capsized from the launching apparatus, the fact being that she did not fit the ways. Admiral Milne, with his usual kindness and courtesy, suggested to me: “Do not be disheartened with that; rest assured you are in the right direction. But why cannot you put your means of flotation, that is, the air-tubes, outside your boats, instead of inside? Our Officers all complain that the manner in which lifeboats are fitted with air-tubes inside is exceedingly inconvenient, and occupies a great deal of unnecessary room.” He maintained, as I afterwards proved satisfactorily, that by placing the tubes *outside* the boats I could get the buoyancy I required. I may say that by using steel as a material, I am enabled to produce a raft and boat, not occupying more than 12 feet length of the vessel, and acting as a Captain’s bridge, that will save 250, if not 300 people, providing accommodation for stores and provisions for twenty days for that number of persons, the weight of the boat and raft not exceeding 5 tons. The model before you (Figs. 14, 15) represents the section of a ship with a raft or launching platform. The model is on the scale to fit a vessel of 40 feet beam. The launching platform constitutes the raft which has a double deck (Fig. 16). When it is put under water, it rises and empties itself entirely, as you see. The boat is a decked double cylinder-boat (Fig. 17). I first get the boat into the water, 15 feet from the ship’s side, and then the raft by a similar arrangement, and the two together will hold 250 people. The raft and the boat can be launched from either side of the vessel instantaneously; you simply have to withdraw a bolt, as in my opinion anything connected with the lowering or launching of boats should be done instantaneously by one action and by one man. I further contend that every boat ought to be a decked boat, and that an undecked boat is absolutely unsafe. She must have weight in her, which I supply in the way of provisions, as if she has not such weight, she must have water as ballast. Of course, it is of no use having a boat or a raft unless any sea coming in can go out as fast as it comes in, and these boats are arranged for that purpose. If you had a raft of this kind 60 feet long and 20 feet wide, it would carry 300 people, and occupy in effect no space over 2 feet in depth more than the ordinary bridge of the vessel, and would not weigh over 4 tons.

Admiral FISHBOURNE: Allow me to ask how far they are unsinkable, that is to say, what amount of injury will deprive them of flotation power?

Mr. THOMPSON: Nothing but a total smash up. They are in about fifty or sixty compartments.¹

¹ The Chairman, having ruled that my time had expired, I was unable to sum up my remarks, which would have been to the following effect:

1. That undecked boats are dangerous in a sea way, being liable to be swamped or capsized, and that the present mode in which they are carried on board ships is unsatisfactory, as are the means used for getting them afloat;

2. That no ship should be allowed to proceed to sea without a sufficiency of duly provisioned boats and rafts to save everyone on board;

3. That the decked “cellular-sided” steel boats and rafts, of which I produced

Mr. LANDER: I am like Mr. Thompson; I have been a great many years in the boat trade and have served a few years at sea. I think men who have been to sea are best able to judge what is most requisite for saving life at sea. It is our duty, as Englishmen, to sit down and study the best means of saving our fellow creatures' lives. I have been, ever since the loss of the "Northfleet" seeing what means I could devise to save life at sea. I have been engaged for a great many years in fitting up lifeboats for passenger ships, and I have found that tanks inside boats, if they get stove in lowering or in any other way, are almost useless. I do not see the good of those copper and zinc tanks that we put into boats for saving passengers on passenger ships, for the tanks are very little service until the boat is full of water, and what is a crew going to do with a boat full of water? She is almost useless. Not only that, but we find the tanks inside our lifeboats are very cumbersome. When our boats are crowded with oars, and so on, there is scarcely room for the crew, let alone passengers. I dare say some gentlemen present may have been overhauling these lifeboats, as they call them, for saving ships' crews at sea (for passenger ships are compelled to take them, according to the Board of Trade), and you would find, if you were to get into one of them, by the time the crew is there, there is very little room for passengers. You might certainly stow some under the thwarts. Then, when we lower our lifeboats, we find, on a dark night, one man runs to the fore davit and another to the after davit to let go the falls, and perhaps the man at the fore davit cannot see what the man is doing at the after davit; he lets go, and the consequence is the boat is bottom upwards in a very short time. Mr. Clifford has a plan that I saw used the other day. It is a very good idea, but as soon as the boat got into the water the men had to overhaul the whip; it took him a minute or a minute and a half after it was lowered. I have a method here which unhooks itself. It is simple. We all know what seafaring men are; the less they have to do with machinery the better. I will now show you my plan of collapsing rafts (Figs. 1 and 2). I have here falls by which to heave the raft up. By letting go the falls, which work round a drum, the raft would be in the sea in an instant. I have a large raft at Newhaven, 24 feet long and 9 feet wide. It consists of cork and light wood, and three inches solid cork round the sides. I put in the thwarts at each end above the hinges, which prevents them closing. I have stanchions and a man-rope to go right round. I have rowlocks for oars, all fast inside. In the one I have at Newhaven, I have a spraycloth passed right along, and it comes up and forms 3 feet of bulwark. I have a bread tank that holds 1 cwt. of bread, and a water tank with 26 gallons of water; an axe, and everything that is required, all on board. There is a mast and lug sail. The weight of the raft would not be so heavy as that of the common lifeboat. Weight is an important element in a boat to be carried on the davits.

Captain CROZIER, R.N.: May I ask what use that raft would have been to the "Eurydice," when she turned over the other day?

Mr. LANDER: It would have swung clear of the ship.

Captain CROZIER: Why would that have saved life on the "Eurydice," any more than any of her own boats?

Mr. LANDER: It is unsinkable.

models, being very light and unusually strong, and capable of being carried in such a manner as to be no hindrance to the working of the ship, fulfil the foregoing requirements, inasmuch as a boat and a raft, each 40 feet long by 12 feet wide, which constitute a bridge on board, can carry 250 to 300 persons, weigh less than 5 tons, and are capable of storing water and provisions for twenty days; further, that the method I showed for launching and lowering boats (the latter by diagrams) is all but instantaneous in operation, and immediately available, and that, in both cases, the boats are placed in the water 15 or 20 feet from the ship's side, which obviates the risk of swamping. At the same time I wished it to be understood that I did not undervalue subsidiary means, such as the hammocks recommended by Admiral Ryder, or even the light cork boats of M. de la Sala, either of which might give persons confidence in going into the water, and afford them flotation until picked up by the boats, as, under certain circumstances, there might not be time, or it might not be prudent, to embark passengers in boats previous to launching.—E. T.

Captain CROZIER: Her own boats were unsinkable, if they came up; but they never came up.

Mr. HOLMES: It is hardly fair to put it in that way. If all the crew and passengers, &c., are below, and the ship goes down, it is almost impossible for any of them to be saved.

Commander GILMORE: Is there no means of turning the davits inwards?

Mr. LANDER: You turn the davits, raft and all, inwards, the same as any other boat.

Commander CURTIS: Do I understand you lower the raft without any people on board, and the people have then to get into it?

Mr. LANDER: Yes.

Commander CURTIS: That is to say, the passengers have to scramble on to it after it is afloat?

Mr. LANDER: Yes. I think I would rather take my risk of getting on to a raft like that than be launched into the water. I have no faith in launching rafts or anything from the broadside of a ship. If a ship should happen to roll just when Mr. Thompson's raft got on the balance, where would it be?

Commander CURTIS: I think it would be an improvement if you had a kind of traveller, and had towing hawsers, because you do not appear to have explained how it would go if the ship is at speed. If the ship was to give a roll, your raft would go into the ship's side.

Mr. LANDER: It would not hurt it; it would not be like a boat. If a boat did, she would be stove.

Admiral RYDER: What was the weight of the boat you built?

Mr. LANDER: I could not give the weight exactly; I should think about the same weight as a common lifeboat, by the time it was fitted up with tanks and water.

Mr. ROPER: I explained my model on the former occasion, but I will show the arrangement for lowering it. My raft takes up the ordinary position of a Captain's bridge. Instead of having a deck that will sink with the vessel, I put a floating power, built on the cellular principle, with either a flat, round, or corrugated bottom. The bulkheads going across, form a transverse girder, and if a ship was to founder suddenly, then, by the simple action of a lever sliding a series of bolts through the iron girders it rests on, the raft is free, and it would float away; or if the ship was on fire, and it was necessary to leave the wreck, then, by lowering the bulwarks, you can prepare to launch your raft, which is done by throwing two levers down that release two tumblers, similar to letting go an anchor from the cathead of a ship; you then lower it either by a tackle or a brake, or by any other simple arrangement. The raft carries watertight seats holding provisions, a compass, ropes, masts, stores, and sails. We have everything ready; there is no rope to cut away, but everything is ready, and in the dead of night a lad, or even a lady, could launch it. In the case of the "Eurydice," if the tops of the chart and deck houses had been made on the cellular principle, they would have floated. The upper deck of a war-ship could be fitted upon that principle. I have a block model, showing the upper part of the "Glatton," one of your war-ships. This flying deck might be formed into a raft on the same principle, and would be self-floating. And then the space outside the armoured round the turret could be made into a series of floating rafts, in case of foundering. I have looked at many of the models of our war-ships, and I can hardly see one where a raft on this principle, which is very simple, might not be constructed. Every available space could be utilized in this way. On this upper deck here is a space 28 feet by 24; this could be made into a raft, and would be self-floating. Had the "Northfleet" been fitted with a raft on this principle, I think everyone would have been saved—there was ample time. It carries sails and everything necessary, stowed away as clean as you see in the case on the working model. If there is specie on board, and there is time to get at it, it can be stowed away in these cells, or the mails might be saved in the same way.

Admiral RYDER: Is steel your material?

Mr. ROPER: I prefer steel, in fact, although Mr. Thompson has spoken about steel as if it had only been recently introduced, it has, of course, been used for many years. He has gone rather back in his pedigree, but I think I have the advantage over my friend of about five years, in connection with shipbuilding, and,

in my patent, I have included fitting ordinary decks upon this principle, and making them of steel. I have no hesitation in saying, since my patent has been taken out, there has been a large number of infringements.

Admiral HAMILTON : Would you launch this raft about half way down ? Is there any chance of that arrangement jamming, if she has any way on her ?

Mr. ROPER : No possibility of jamming ; there are friction rollers on the side and bottom.

The CHAIRMAN : What is the result of straining it fore and aft.

Mr. ROPER : The strain would come on to the friction rollers. I may mention that Admiral of the Fleet Sir George Sartorius, has written two letters to the *Times* upon the raft, in which he states that he believes it would live out any storm, and form a breakwater for boats to hang on to.

Admiral FISHBOURNE : Narrowing the two extremities, and making it more ship-shape, would get rid of any difficulty of its jamming.

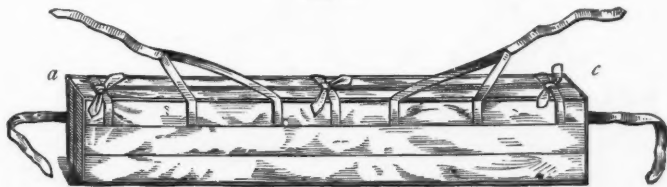
Mr. ROPER : No doubt ; some naval men have suggested that.

Commander GILMORE : My model is not at all on an ambitious scale ; it is merely a raft placed at a convenient point on the ship's deck. (Fig. 7.) It is made in cylinders with a packing of cork to prevent its being broken by the concussion of heavy guns. This [Diagram] (Fig. 9) shows the raft, and, of course, if it stood on the deck in its crudeness, there it would be difficult for men to walk over it, so that I have placed fore and aft on each side an inclined plane for the men to come on it. (Fig. 10.) There are tanks for water and provisions. For lowering boats, on the outside I have an iron shield surrounding the boat, you can either hang the boat on the davit or bring it inboard. As you lower from here, the boat falls out quite clear of the ship's side. This figure (8) represents the raft being launched ; it goes upon rollers ; the bulwarks falling out form a launching way for it. This, however, is merely a makeshift and not on the scale on which Mr. Roper's system is carried out.

The CHAIRMAN : I think I may recall gentlemen who are present to the fact that the paper read touched on the minor means of saving life at sea, such as would be always available where no possibilities of launching rafts or boats existed. I think Admiral Ryder has something still to say on that subject.

Admiral RYDER : I was allowed to make a few observations on the night Commander Gilmore read his paper ; since then Her Majesty's ship "Eurydice" has been lost, and the gravity of the question is, if possible, increased. I thought you would like to see a seaman's hammock with the proposed cork mattress in it, and the waterproof sheet, which, when both are adopted, will bring the "buoyant hammock," according to our present lights, as nearly to perfection as possible. This (pointing to a lashed-up hammock, containing a cork mattress and a waterproof sheet) is about the size of rather a stout hammock for a seaman, but less than the midshipman's or steerage hammock ; this hammock might be made still smaller, by having a little less cork in the mattress, but, of course, at the sacrifice of some buoyancy.

FIG. A.



It has in it a cork mattress, see Fig. A, weighing 12 lbs., with a buoyancy of 60 lbs., which will float three men with their shoulders out of the water. The additional temporary buoyancy, due to the waterproof sheet, exists as long as the water does not get inside the sheet, and is about 60 lbs., or 120 lbs. in all ; six men, resting their hands upon this buoyant hammock, would float with their shoulders out of the

water. The idea of making hammocks buoyant has been carried out in the following way, viz., by stuffing the mattresses with granulated cork instead of hair, the cork being a very much cheaper material, 12 lbs. of granulated cork, which is sufficient to stuff a seaman's mattress, will cost less than two shillings (retail price).

FIG. B.

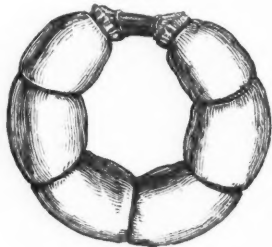


FIG. C.

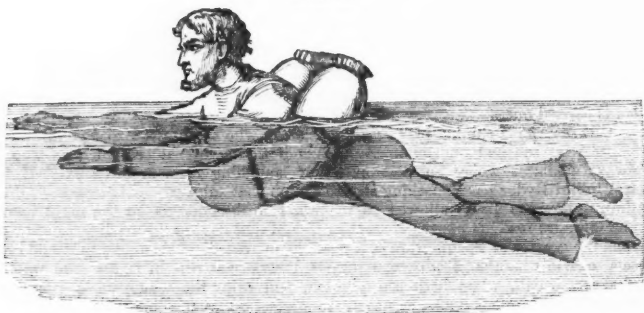
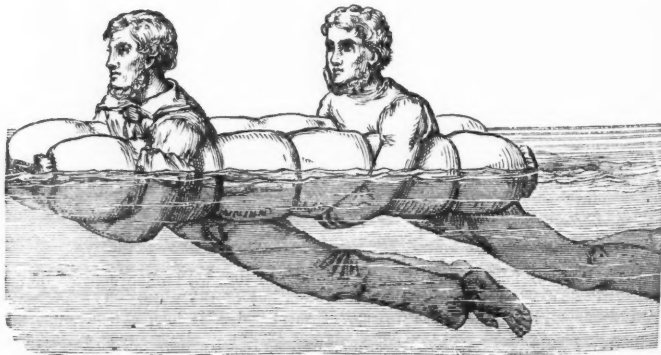


FIG. D.

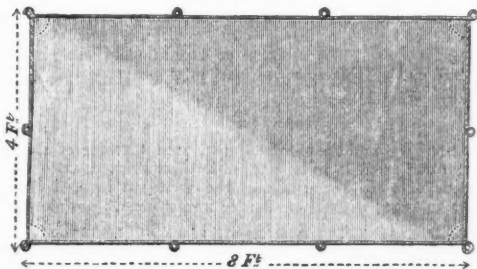


An equal bulk of good horsehair will cost ten shillings. For the sake of the men's comfort, when the Admiralty experiments were tried, four years since, as they criticized the original cork mattress and wanted something more comfortable, I introduced about an inch thickness of hair on the top of the mattress. Such a mattress can be supplied to the men at about the same cost as their hair mattresses, and much cheaper if made in the dockyard. With the waterproof sheet between the hammock and the mattress, the hammock, as has been already said, has not only a permanent buoyancy of 60 lbs., but also a supplementary buoyancy, but not so permanent, of 60 lbs. more. The sailor is perfectly familiar with the way of casting the clews of his hammock adrift. When the man is in the water he ties the clews round his waist, see Figs. B, C, or two men between two hammocks, see Fig. D, with their arms resting over them, are floated almost at their waists. The object of making hammocks buoyant is to enable men-of-war's men to be saved by being floated for a short time when their ships have to be abandoned at very short notice, say in a few minutes. In some passenger ships the mattresses and cushions have, for years, been stuffed with cork, but, as yet, there is no obligation so to fit them. Of course, if there is time to launch rafts and lower boats, it would be madness to neglect them for buoyant hammocks. One of the speakers told us he could launch his raft in one second. Wonders will never cease: he may, perhaps, be able to invent a means of launching a raft in that time, but if he fails to do so, and I am a little suspicious of his success, it is surely advisable, and it is certainly thought so by many, that there be a means on board of saving, that is to say, floating for at least a short time, say a few hours, everybody on board. Such appliances should, evidently, be close at hand, available immediately, and, as far as I have seen at present, I do not know of any other means than utilizing the hammocks, which, in men-of-war, are generally carried on deck. The nettings ought always to be so fitted as to allow of the hammocks being easily extracted. We have had several cases of loss of men-of-war, with, of necessity, almost immediate abandonment. I believe, in many cases, viz., Her Majesty's ships "Bombay," "Orpheus," and others, a large number of the lives might have been saved if their hammocks had been made permanently buoyant. I feel perfectly confident, and I know my opinion is shared by a large number of experienced Officers,¹ that in the "Eurydice," if the hammocks

¹ If the "Eurydice's" nettings were partially boxed in, as has been asserted, the hammocks would have been less easy to extract, but had they been buoyant many would have been got at after permission was given to do so, and for the future "boxing in" should be abandoned.

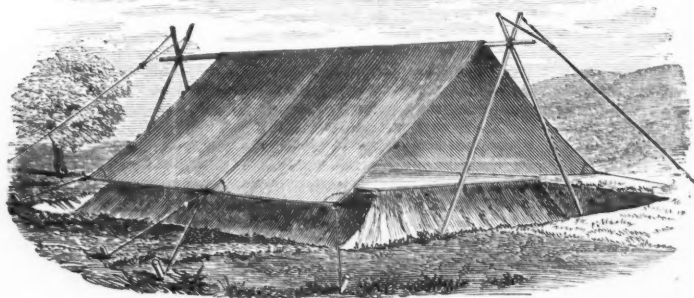
NOTE.—Figs. E and F show the use of the calico waterproof sheets when the men are landed as a Naval Brigade. Sheets of a waterproof (india-rubber) material are issued to our troops in the tropics when campaigning. They are much smaller, much heavier, much more expensive than the stout calico sheets prepared with boiled oil, 8 feet by 4 feet in size, as recommended by me, and they do not stand

FIG. E.



had been buoyant the men who were really standing on them, had their feet touching them, could have extracted many of them, while others would have extracted themselves and floated to the surface. Perhaps the hammock cloth was hauled over and secured, but this could have been cut adrift easily in a few seconds. Having been exercised when bathing, the men would have fastened their hammocks round them, see B and C, and floated safely for a number of hours, varying according to their physical powers of endurance; at all events, they would have had the same chance of being picked up as the two men who were lucky enough to come across the two life-belts in the water. After Commander Gilmore's lecture in this theatre, a

FIG. F.



rough usage nearly so well, nor are they easily repaired; the short campaign in Malacca ruined them.

It will be seen that there is a light roping with beekets round each calico sheet. The sheet weighs, after being waterproofed and roped, less than 4 lbs.

The size selected by me, 8 feet by 4 feet, is sufficient to protect three men of moderate size from the damp when lying down on ground, prepared as in F with a surrounding ditch, and two sheets will form a *tente d'abri*.

The sheet affords a perfect protection as a cloak to men on sentry.

The Chinese, at Hong Kong and elsewhere, largely use waterproof preparations of boiled oil for clothing. The man I employed at Hong Kong to waterproof several sheets would not give me the receipt, but I ascertained that the ingredients were boiled oil, soft-soap, and bees-wax. I have tried experiments and found that one quart of oil, with which had been carefully mixed one ounce of soft-soap and one ounce of bees-wax, boiled down to two-thirds and rubbed into calico dried in two or three days, and after that was neither sticky in extreme heat nor stiff in cold—boiled oil when used alone will not stand extreme heat, but sticks. A thoroughly satisfactory waterproof sheet will enable the Commander-in-Chief, when organizing a naval brigade in the tropics, to dispense with great coats and blankets, provided the men are dressed in serge. The adoption of a satisfactory waterproof sheet for the Royal Navy will answer, therefore, two important purposes, viz., largely increase the buoyancy of the hammocks, and place our men in the same, I may go further and say in a much better, state of preparation for a campaign on shore than their brethren of the Army.

I have distributed round the theatre the annexed Circular of the Society of Arts. If the Council will allow it to be printed in their Journal, attached to Commander Gilmore's paper, of which paper and of the discussion here, it is one of the most important results—they will help to confer a great benefit, not merely on our Officers and men, but on the profession generally and the country at large. The Journal of the Royal United Service Institution penetrates where the announcement and offer of the Society of Arts will not reach unless attached as I suggest.—A. P. R.

Mr. Hely wrote to me and said that about thirty-two years ago (and I was able to substantiate all his statements) he brought an invention for saving life by means of waterproof covers to hammocks, &c., before the public, that Prince Albert inspected it at Portsmouth, and the Admiralty sent down Officers to report on it, also that he received the Isis Medal from the Society of Arts for it. Mr. Hely's invention, now over thirty years old, was really what I fancied had not been previously thought of, until I brought it under the notice of the Admiralty four years ago, viz., having a waterproof covering for each mattress. Mr. Hely crossed over to Calais on a raft made of these buoyant sacks, and he was the first person, as far as I know, who brought to a practical trial the obtaining buoyancy by having waterproof sacks, &c. I cannot help thinking a combination of the two is the best thing we could have, the cork mattress, which gives a permanent buoyancy of about 60 lbs., and, in addition, the more or less temporary buoyancy of the large waterproof sheet, not less than 8 feet by 4 feet, between the mattress and the hammock.

Mr. CULLIS: I may perhaps claim to occupy a few minutes of your time on the ground that I have devoted some attention to this matter, and have worked out some of the details of this raft of Mr. Roper's. For this reason I am very likely to be prejudiced in favour of it, but premising this, I wish to point out one or two weak points, as they seem to me, in the schemes before you. Señor de la Sala has brought forward a valuable and interesting invention, but the objection to this and similar schemes is that it does not meet the great difficulty and necessity of providing for the escape of a large number in a body, and of affording them some means of sustenance if shipwrecked in mid-ocean. I venture to say that death at once is almost more desirable than the prolonged torture endured by a man cast away in a tropical sea, perhaps, with his head kept above water. With regard to all these inventions for providing individuals with means of flotation, the weak point is that you provide for isolated units, but the raft system has the advantage of keeping them together, so that the strong are able to help the weak, and women and children stand some chance of escape, and then you have provisions at hand, which also is a very important point in favour of the raft. Other reasons can be urged why the raft or boat system is so preferable, such as the possibility of navigating such life-saving apparatus and making for the nearest land. We have in the raft or boat system of Mr. Thompson, no doubt, a very ingenious one. I had the pleasure of seeing the first experiment to which Mr. Thompson has alluded, and I must confess that my satisfaction was somewhat marred by the upset of the boat on this trial. Of course such accidents are very liable to happen in first experiments, but it seems to be a grave objection to this scheme that you launch the raft and boat from so great a height. You must at least have seven feet under your beam to afford head room; that throws your launching apparatus up very high, and centred as the beam is amidships, you necessarily raise one end of the beam as much as you lower the other, throwing up one end of your raft to a great height and dangerously increasing the angle of your launchway. This difficulty is obviated in Mr. Roper's raft by lowering the launching beam from either end, as circumstances require, right down on to the deck, thus launching with a much gentler slope (just half the angle which the beam makes if centred amidships), and you have also the great advantage of the outboard sliding rails, which almost brings the launching end of your raft into contact with the water before the other end has left the ship. Then I think it must be patent to everybody that a raft of the dimensions and construction shown in Roper's model is very much less likely to capsize (indeed it is almost an impossibility) than any structure of the boat shape. You have also the advantage of making the very utmost of the room at your disposal. In Mr. Thompson's boat-raft you have rounded ends and bottoms, which, however advantageous for some things, involve some loss of space. It is obvious that, as compared with any boat-formed structure, the flat rectangular raft secures the maximum of buoyancy with the least demand upon the ship's space. Roper's raft is constructed on the cellular principle, which is the very best possible for gaining strength and buoyancy. But I think, if, point by point, careful comparison be made of the advantages of the respective plans—for instance—as to buoyancy, space occupied in proportion to the numbers carried, facility in launching, strength and stability, Mr. Roper's system would be found to have the advantage every way. On a raft of this size, you could carry

nearly 400 as against the 250 persons Mr. Thompson proposes to provide for. The weights of raft have been carefully calculated, so have the weights of passengers and provisions and the displacement; and I may very safely say that such a raft of these dimensions would accommodate 400 persons with provisions and all appliances.

Captain CROZIER, R.N.: May I ask the dimensions of the raft?

Mr. CULLIS: 40 by 20.

Captain CROZIER: You could not carry 400 people on it. I am under the impression that the question of saving life which at the present moment we are discussing is not so much with regard to merchant ships as to ships of war in the event of collision or action, and I take it that that raft would be very little service to us in the event of a general action taking place. That raft in the first place would be liable to be destroyed by shot or shell. There is another thing to be said also as far as that raft is concerned. It is a very simple matter to lower it into smooth water, but when a ship is rolling 30 or 40 times a minute it becomes another question, because at the time the ship was rolling she would be more or less disabled, and she would roll possibly almost as much to windward as leeward. If it gets away from the ship what is to prevent it being smashed up by striking the ship as it meets the ship on the roll? How are the people to get on board? I take it the kind of thing we require is some means not so much for launching rafts (when there is no time to do it) but for the water to act upon a portion of the ship's deck and so float that portion away and allow the men to get on till assistance can be secured. We always as a rule place water and a certain amount of provisions in our boats ready for lowering, but I take it all the appliances we have seen, excepting the hammock which Admiral Ryder has spoken of, would only be of use to us under circumstances where we have nearly smooth water, or at all events when the ship was going down through a leak or anything of that kind, but not in a heavy gale of wind, with the ship rolling and I may say being perfectly unmanageable. I had the honour of commanding a small ironclad gunboat some time ago; she was divided into compartments, and the hatches which formed her principal safety were screwed down when the ship went to sea in order that the water should not get below, and so that she would have a certain amount of floating power. It seems to me there is very little difference except that these were iron. We might have a portion of our hurricane deck or quarter deck secured in such a way as in the event of a ship suddenly coming to grief, with a sharp knife or something of that kind a portion of the deck might be disengaged which would afford some means, at all events, of saving life. When the "Eurydice" was capsized, there were vessels in sight, and if a portion of the deck only could have been kept afloat, a certain proportion of her crew would have been saved. The appliances we have seen, although useful in merchant vessels, would be of little or no importance to us if the ships were engaged in a naval action.

Mr. ROPER: I think I have explained that for a man-of-war, my principle can be adopted to form the ordinary deck of a vessel; it is in my patent that a deck could be self-floating in case of foundering, and the tops of the deck houses also.

Mr. THOMSON: Mr. Roper has made some observations as against my principle. I consider his a most inconvenient arrangement, because the structure stops the action of the deck absolutely. The fact is I get really and absolutely a nearer approach to the water than he does, and certainly more quickly. There is no appliance in mine except one single action. I object also to cutting the bulwarks.

Mr. WOOD: One gentleman spoke with regard to rafts in case of a ship in action being liable to be struck by shot or shell. Of course Mr. Roper has not placed before you a raft which is shot-proof, but by a simple mechanical arrangement, it can be lowered on to the deck, and I imagine it would then be protected from broadside fire. Besides that, even if struck, being partly composed of cork it would retain its buoyancy to a considerable extent. With regard to the launching of a raft I should imagine the weight of it would give it a velocity that would carry it almost clear of the ship.

The CHAIRMAN: I will say one or two words, which are these: that in this Institution we have no sympathy whatever with rival inventors. We are here to discuss a great object, that of saving life at sea under circumstances of difficulty and danger, and if gentlemen who come here would only recollect that what one invention may

supply in one direction may be still better supplied in another direction, they would not waste so much time in arguing a question which does not interest an Institution like this. It is quite clear to us on board men-of-war we have to consider a case in which the ship herself is not proof against shot, and still less in structure of deck. Her bulwarks would offer no protection whatever against such shot as would be directed against them. Under those considerations it may be easily seen how an Officer with the experience of Admiral Ryder, has chosen rather to advocate that which is not subject to those disadvantages. This hammock would unquestionably prevented a very large proportion of the loss of life that we all regret took place since I last occupied this chair. It is not a question to-day of what you would do if you had plenty of time, and how you would utilize well devised appliances, but it is what you should do in order that each man may feel (particularly on board a man-of-war) knowing when the ship is sinking from under him, and the boats are all shot to pieces, that there are still floating objects to which he may address himself in order to save what is left him—his life. In a fleet action it is quite clear that there would be sufficient aid at hand to pick up those able to float about for a time. So generally in such cases as the "Eurydice," not far from land, subject therefore to heavy squalls which she might have passed through quite regardlessly had she been in the open sea, there was a position in which unmistakably these hammocks would have saved life. We all know that if a shot struck any machinery of that kind (pointing to a bridge-raft) you could not rely on the action of a single portion of it, a lever is bent, something goes wrong, and it won't work. But with a hammock no such objection exists; they are already in the hammock-nettings on the edges of the ship, and they are there detained by so very slight protection as to be easily got at by any seamen at any moment. The instant a sailor comes up on deck, finding his ship sinking under him, he is able to rush to his hammock, having been thoroughly drilled to the use of it, and knowing beforehand that it will afford him perfect safety. Under those conditions he retains the presence of mind which you would in vain seek for by any uncertainty whatever. With these few observations I will call upon Commander Gilmore to make whatever reply he deems necessary.

Captain CODRINGTON, R.N. : I have heard it stated several times in public that the hammocks were so exceedingly accessible, but I beg leave to call attention to the fact that the "Eurydice's" nettings were built in a wooden and not in an ordinary hammock box. I think Sir Leopold McClintock will bear me out in that, and the whole of the outer part of the netting is wood with iron bands over, and a very small portion of hammock cloth at all. It would be a very difficult matter to get the hammocks out of the netting. They could not float out, the men could not cut the cloth off, and under all ordinary circumstances it is necessary for the men to drag them out of the nettings.

The CHAIRMAN : All naval Officers present will recollect that that must be classed under extraordinary fittings.

Captain CODRINGTON : No, every man-of-war at the present time is fitted in that way. I do not know any ship that is not at the present moment.

Commander GILMORE : The short paper I had the honour of reading the other night was more for the purpose of creating discussion upon this very important subject than for the value of the paper itself. To-night we have had some very beautiful designs shown us for saving a number of men when there is time for launching a raft, or for saving individuals also in great number when Admiral Ryder's hammock is used. It is very strange that in this Institution we have models of every weapon for killing people, from the bow and arrow of the savage to the torpedo and the 600-pounder of this highly civilized age, but beyond the models here, there is not in the whole of this Institution any apparatus for saving life. I think it is a very extraordinary circumstance. I had hoped the discussion here might have found its way to the Admiralty. I believe, however, that there is no one here from that Department. I should like, however, to suggest to the Council, that a Committee should be formed to take this matter into consideration and bring it under the notice of the Admiralty. It is a most important subject, and I am very much obliged to all the gentlemen who have taken part in the discussion. I hope it may be productive of good.

The CHAIRMAN : It remains that I should ask you to give a vote of thanks to the reader of the paper, and also to those gentlemen who have been kind enough to show us their models, which are of the greatest interest.

APPENDIX.

SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES, AND COMMERCE,
John Street, Adelphi, London, W.C.

SAVING LIFE AT SEA.

GOLD MEDAL.

COMMITTEE.

T. Brassey, Esq., M.P.; Donald Currie, Esq.; Admiral Nolloth; Admiral Sir Erasmus Ommanney, C.B., F.R.S.; Capt. Price, R.N., M.P.; Admiral A. P. Ryder; Admiral Sir E. Sotheby; Capt. Toynbee.

The Council of the Society of Arts offers its Gold Medal for the best means of saving life at sea, when a vessel has to be abandoned suddenly, say with only five minutes' warning; the shore or other vessels being in sight.

1. Preference will be given to appliances to which fewest objections are established, on the score of their occupying valuable space, interfering with the stowage of more important articles, being in the way, being unsightly, not being ready at hand, requiring more or less "fitting" when brought into use.

2. Preference will be given to appliances to which fewest objections are established on the part of medical men, on the score of the appliances being unhealthy.

3. Preference will be given to appliances to which fewest objections are established on the part of seamen, on the score of their being uncomfortable, inconvenient, &c.

4. Preference will be given to appliances which afford a buoyancy of, at least, 40 lbs. to each person on board, whether of the crew or a passenger.

N.B.—The cork life-belt, usually supplied, has a weight of 5 lbs., and a buoyancy of 20 lbs. It will float a man of ordinary dimensions, with his shoulders just a-wash, provided all the rest of his body is under water. The life-belt placed in their boats by the Royal National Lifeboat Institution has a buoyancy of about 25 lbs., but only weighs 5 lbs., owing to the superior quality of the cork.

5. Preference will be given to means of flotation which utilize articles already existing on board, so that no extra space will be required.

6. Preference will be given to appliances that are the least expensive, as to first cost and annual repair.

7. Preference will be given to appliances best able to stand the variations of climate, rough treatment, &c.

8. Neither boats nor rafts will be admitted to the competition, as it is almost certain that in the contemplated cases of abandonment neither of them could be lowered or cleared away in time, and because, even if the boats stowed outside could be cleared away, there would rarely be sufficient space to provide means of safety for all the crew and passengers.

NOTE.—Of course, if there were time to clear away boats or rafts, they would be first attended to.

9. Cork belts, with a buoyancy of less than 40 lbs., will not be admissible, as it is most important that the mouth and nostrils of every one in the water be raised as far as possible above the surface. The ordinary life-belt, admirably suited for use in boats, and to support in the water persons accustomed to immersion in it, would frequently be quite insufficient in the cases contemplated for all non-swimmers, especially women and children.

10. No preparation of india-rubber or gutta-percha will be admissible, as with the

greatest precautions they are not sufficiently proof against the effects of climate and of ill-usage.

NOTE 1.—It is to be understood that, under the special circumstances of the cases contemplated, all that is aimed at is to preserve life until the shore is reached, or the immersed persons are picked up. For this reason no provision is expected to be made for food or water.

NOTE 2.—Competitors are at liberty to draw a distinction between appliances most suitable to men-of-war, to passenger ships, to ordinary merchant ships; also between the different circumstances attending a sudden abandonment by day and a sudden abandonment by night.

The Gold Medal will be awarded for the appliance, or combination of appliances, which answer in the highest degree the various qualifications named above; but the Council is at liberty to withhold the Medal if, in the opinion of the Judges, nothing is submitted worthy of the award.

Appliances intended for the competition must be sent in not later than the 31st October, 1878, addressed to the Secretary, Society of Arts, John Street, Adelphi, London, W.C., and must in every case be accompanied by a *short* description.

By order,

P. LE NEVE FOSTER, *Secretary.*

April, 1878.

NAMES OF MEMBERS who joined the Institution between the 1st July and
the 30th September, 1878.

LIFE MEMBERS.

Cartwright, H. A., Lieut. 68th Regt.	Campbell, C. Walter, Capt. Bengal S.
Anson, Chas. V., Commander R.N.	Corps.
Brookfield, A. M., Lieut. 13th Hussars.	Fogo, J. M. S., Dep. Surgeon-General,
Chamberlain, Sir Neville B., G.C.B.,	A.M.D.
G.C.S.I., Lieut.-General H.M.I.F.	

ANNUAL SUBSCRIBERS.

Elliott, G. H., Lieut. 3rd Ben. Cavalry.	Chater, Vernor, Capt. 91st Highlanders.
Alison, Sir A., Bart., K.C.B., Major- General.	Lloyd, T., Capt. late 87th Regt.
Holman, J. R., M.D., Fleet Surg. R.N.	Izat, Geo., Lieut. R.N.
Bourke, J. Mc. W., M.B., Surgeon-Major A.M.D.	Jackson, Hugh M., Lieut. R.E.
Stover, Henry, Colonel R.A.	Daniell, R. T., Surgeon 2nd Middlesex Art. Vols.
Essex, Edward, Capt. 75th Regt.	Guyon, H. J., Lieut. 102nd Regt.
McNalty, Geo. W., M.D., Surgeon-Major A.M.D.	Walker, A., Major R.A.
Du Vernet, F. T. C., Lieut. 56th Regt.	Shakespear, Geo. R. J., Capt. Bengal S. Corps.
	Coles, Walter, Lieut. R.E.

OCCASIONAL PAPERS, NOTES,

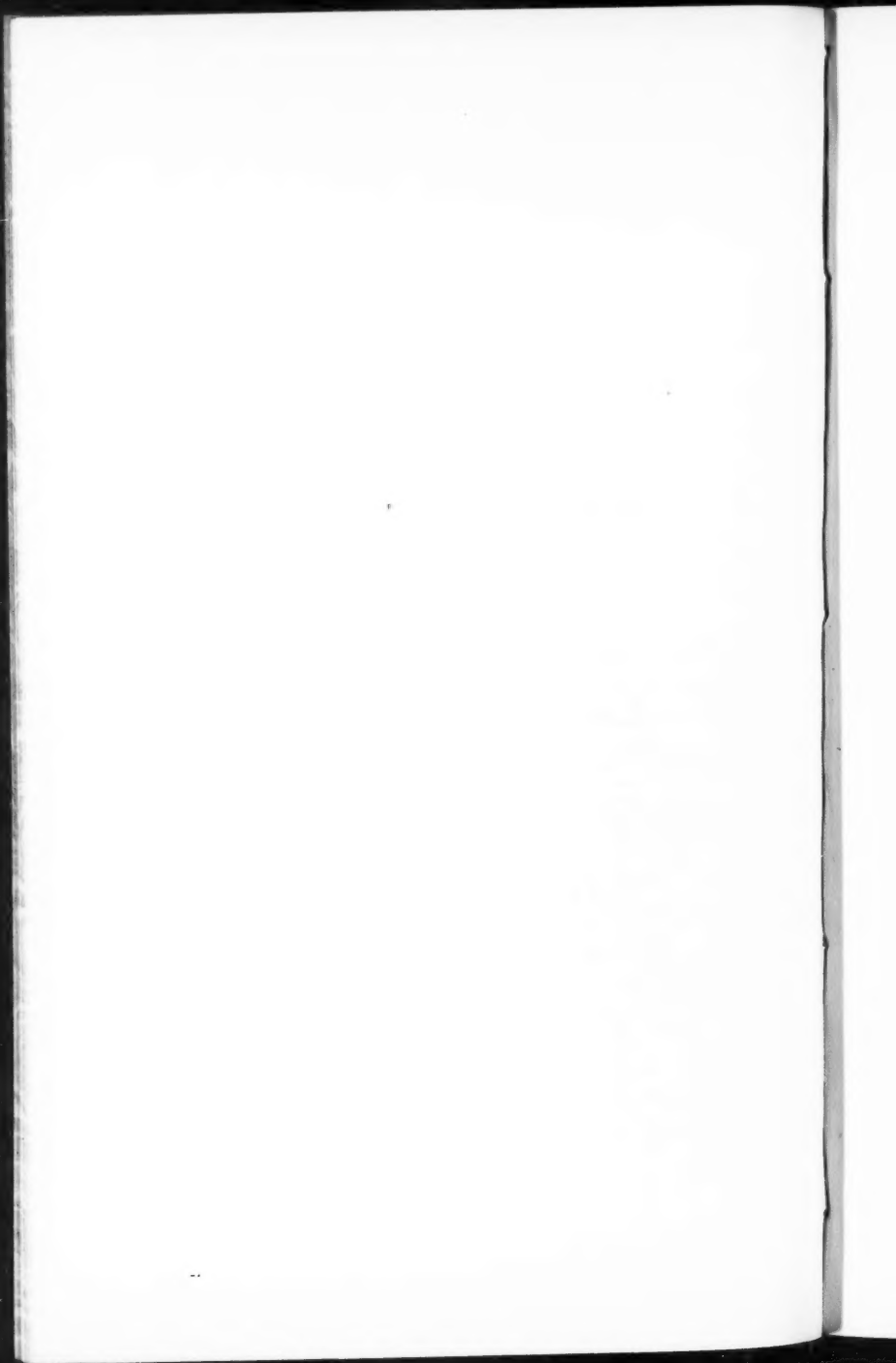
AND

NOTICES OF BOOKS.

This portion of the Number is reserved for Articles, either Original or Compiled, on Professional Subjects connected with Foreign Naval and Military matters; also for Notices of Professional Books, either Foreign or English.

It is requested that communications, or books for review, may be addressed to

LIEUT.-COLONEL LONSDALE A. HALE,
Royal Engineers,
Royal United Service Institution,
Whitehall Yard, London, S.W.



MUSKETRY INSTRUCTION AND LONG-RANGE INFANTRY FIRE IN AUSTRIA, FRANCE, AND PRUSSIA.

By Lieutenant WALTER H. JAMES, R.E.

MUCH attention has been lately given in England to the question of the best strength of the company, the modern tactical unit for infantry, and although such discussions are useful, both from a theoretical and practical point of view, still there has been, perhaps, too great a tendency to forget that although the form in which British infantry is to be brought against a future enemy is of great importance, the actual preparation of the *individual* soldier for the manifold requirements of the fighting of to-day is not less worthy of consideration. The drill formations may be excellent, but if the soldiers are not thoroughly imbued with the spirit of modern combat, do not feel thoroughly at home in the various phases of the fight, are not able in all circumstances to make the best use of their weapons, they will labour under a disadvantage when opposed to troops who have been educated to feel that a battle differs only from a sham-fight in the fact that the weapons of the enemy are pouring out deadly lead instead of harmless powder smoke; but that the confusion of combat, the rapid aiming which is necessary, the quick appreciation of distance, are familiar to them from their practice in peace.

From time to time various prophecies have been made as to the particular cause which will lead to success in the next great war. Now it is to the proper use of artillery, to the development of shrapnel fire, or the employment of mounted rifles. Such prophecies have often been realized, for they were but deductions from very obvious premises, and so we, taking into consideration the highly complex character of modern fighting, may now most confidently predict that the nation which first educates its troops in the true character of modern warfare, teaches them to do in peace what they have to do in war, and subordinates to that end the whole training of the soldier, will place itself in such a position that if it cannot exactly command success will at least have gone a long way on the road to it.

Now one of the most important parts of the training of the infantry soldier is the proper use of his weapon under the varying circumstances of the fight. The great military nations of Europe have latterly been paying much attention to this portion of the instruction of their infantry, and it has been thought that an analysis of the systems pursued in Austria-Hungary, France, and Prussia might not be without interest to the readers of the Journal.

Much will be found in the following pages that will be new to some of our readers, but we believe that a perusal of them will show that, while our system is on the whole sound, there are at least some points on which we may receive instruction from our neighbours.

Before proceeding to the systems of instruction, it may be well to describe the weapons with which the infantries of the three Powers are armed.

The Austro-Hungarian rifle, known as the Werndl, resembles some-

what in the outward form of its breech mechanism the Snider-Enfield. The Gras and the Mauser rifles,¹ the weapons respectively of France and Prussia, are bolt breech-loaders. The Werndl was introduced into the Austrian Army after the campaign of 1866, while the Gras and Mauser are the results of the war of 1870-71, and may be considered as representing the latest development of infantry arms.

The Werndl, in its original form, was somewhat behind the age; but by the introduction of the new cartridge with a heavier bullet and larger powder-charge, it has reached the first rank of weapons. Experiments have been for some time in progress in Austria with different forms of magazine weapons, but at present no decision appears to have been come to as to whether they should be introduced or not. The following table gives the principal dimensions of the above-mentioned arms:—

	Austria-Hungary.	France.	Prussia.
Weight of rifle without bayonet.....	9 lbs. 3 ozs.	9 lbs. 4 ozs.	9 lbs. 10 ozs.
" " with bayonet	10 lbs. 14 ozs.	10 lbs. 8 ozs.	11 lbs. 5 ozs.
Length of rifle without bayonet.....	4 ft. 2 ins.	4 ft. 3 ins.	4 ft. 5 ins.
" " with bayonet	5 ft. 9 ins.	5 ft. 11 ins.	6 ft. 0 ins.
Calibre across the lands	·421 ins.	·433 ins.	·433 ins.
Number of grooves	6	4	4
Inclination of grooves	1 turn in 28·74 ins.	1 turn in 21·66 ins.	1 turn in 21·66 ins.
Extreme graduation of sight	1,161 yds.	1,968 yds.	1,750 yds.
Weight of bullet	371 grs.	386 grs.	386 grs.
" powder charge	77 grs.	81 grs.	77 grs.
" cartridge complete.....	656 grs.	676 grs.	660 grs.
Muzzle velocity.....	1,437 ft.	1,430 ft.	1,410 ft.

The Werndl rifle is sighted from 200 to 1,400 paces (164 to 1,161 yards), and the sighting arrangements are similar to those employed with the Snider and Martini-Henry. There is, however, a peculiarity in the mode of employing the sight that is worthy of notice. As a rule the slide of the back sight is pushed so far up the sight that it rests on that step of the frame of the back sight, representing a range of 300 paces. This is called the standing sight (*stand visir*), and is to be always used for standing or moving objects up to a distance of 400 paces. When using it an infantry soldier would be struck in the upper part of the body up to a distance of 300 paces, in the lower between 300 and 400 paces. If small objects are to be fired at within 300 paces, as will often be the case in fighting in dispersed order, the slide of the back sight may be placed accordingly. The lowest position of the slide is for 200 paces, but as the trajectory is very flat it is not considered necessary to allow for the rise of the bullet when firing at objects within that range. When, however, it is necessary to hit a very small object in the centre, the soldier may aim—

¹ Specimens of the Werndl, Mauser, and Chassepôt (the mechanism of which is nearly the same as the Gras) are in the Royal United Service Institution Museum.

5 inches under the mark at an object 50 paces distant.

7	"	"	"	"	100	"	"
6	"	"	"	"	150	"	"

The construction of the back sight does not permit the slide to be placed for distances between 500 and 550 paces. With all other ranges between those for which the sight is graduated, the slide is to be placed between the graduations according to the judgment of the soldier.

The back sight of the Gras rifle is hinged the reverse way to that usually employed by us, and is in two parts, the one sliding up to the top of the other to give the extreme range, which is 1,800 metres (1,968 yards). It is graduated at 25-metre intervals, except from 1,200 to 1,400 metres, where the construction of the sight does not allow this to be done.

The following are the rules for the employment of the sight:—

Up to 250 metres the sight for 200 metres is to be used. Between 250 and 350 metres that for 300 metres. Between 350 and 400 metres that for 350 metres. Between 400 and 800 the back sight is to be adjusted to the nearest graduation.

The Mauser rifle presents several peculiarities in the method of sighting. In the first place there is a standing sight used for ranges up to 270 metres (300 yards *ca.*), a flap sight which can be used up to 360 metres (400 yards), and the ordinary back sight, which is in two parts, the one pulling up over the other, and which gives an extreme range of 1,600 metres (1,750 yards), with 50-metre divisions from 400 to 1,100 metres, and from 1,200 to 1,600 metres. The construction does not permit subdivisions in the graduations between 1,100 to 1,200 metres.

The various sights are employed as follows:—

Standing sight, against objects half the height of a man within 270 metres (300 yards), against recumbent objects or men's heads within 200 metres (219 yards).

Flap sight to fire at infantry standing in the open up to 350 metres (383 yards), or at broader objects half the height of a man from 270 to 350 metres (300 to 383 yards). Against cavalry, the back sight set for 400 metres is used from 350 to 400 metres, from 350 metres to muzzle, the flap sight is used.

When the back sight is used for 450 metres and over, the dangerous zone¹ extends but a short distance in front of the point of impact, and therefore great accuracy in judging distance is required. When the object aimed at lies towards the extremity of the range for which the back sight is adjusted, as, for example, an infantry soldier at 480 metres, or a cavalry soldier at 580 metres, it is better to set it for 500 and 600 metres respectively.

In Austria and France the men are taught to aim at the middle of the object fired at. In Prussia, however, the lowest point of the mark

¹ English military phraseology contains no expression equivalent to the German "bestrichener raum," or the French "zone dangereuse," *i.e.*, the distance covered by a shot in that portion of its trajectory not more than six feet above the surface of the ground. We have therefore ventured on the expression *dangerous zone*.

(*ziel aufsitzen*) is always to be aimed at; this method it is considered best fulfils the requirements of war, where the object is to hit as many men as possible in some one part of the body, and render them *hors de combat*, rather than to kill a few by hitting them in more vital parts. All three nations aim with a full sight.

The system of instruction differs considerably in all three Armies from that which obtains in England.

In Austria-Hungary the musketry instruction is carried out by the company Officers; but to every battalion is attached a subaltern Officer who has been through the School of Musketry at Brück, and whose duty it is to exercise a supervision over the instruction in both the theoretical and practical parts of the work. It is also his duty to draw the attention of the battalion commander to any departures from the authorised course. Each regiment is further provided with a Captain or Lieutenant, who is charged with the general superintendence of the course of instruction; but whose functions are not more definitely laid down in the official text-book.

It is the duty of the commandants of battalions or regiments to ascertain personally, as well as by the reports of the musketry instructors, that the company commanders carry out the musketry instruction strictly in accordance with the regulations.

In France the system employed more nearly approaches that in use in England. Each regiment has a *Capitaine de Tir* (Captain-Instructor of Musketry) and each battalion a Lieutenant or Sub-Lieutenant, chosen from among those Officers of the regiment who have passed through one of the schools of musketry, Chalons, le Ruchard, la Valbonne, or Blidah, with success. They do not, however, appear to be supernumeraries. The musketry instruction of the regiment is placed under the supervision of the Colonel, the Lieutenant-Colonel arranging the details. The commanders of battalions and companies have the direction of and are responsible for the due instruction of the men. The Captain-Instructor has to be present with every company of the regiment when shooting, and the Lieutenant-Instructors have also to be present with the companies of their respective battalions. These Officers are further charged with the preparation and care of the ranges, targets, &c., and the keeping of the registers.

In Germany the musketry instruction is conducted entirely by the company Officers; but it is recommended that the experimental shooting (*Belehrungs-Schiessen*) and section shooting should be conducted under the superintendence of the regimental or battalion commander. The former because, being carried out with the spare ammunition of the companies, it is well that the whole of these should be collected together, in order that adequate instruction may be imparted to all with the necessarily small expenditure of ammunition, the latter in order to practise the Officers in fire discipline. For this reason, also, it is considered desirable that the squad shooting should be carried out with the various units as near war strength as possible.¹

¹ Evidently by uniting two companies or *züge* on a peace strength to form one on a war footing.

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AUSTRIAN

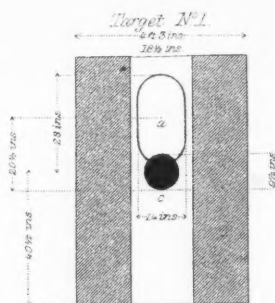


Fig 1.

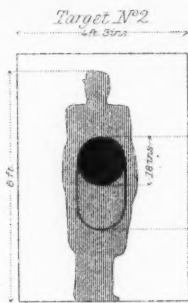


Fig 2.

FRENCH

Round Target

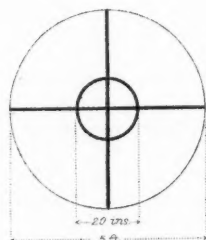


Fig 5.

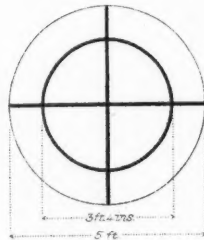


Fig 6.

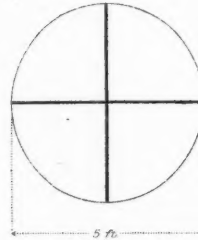


Fig 7.

PRUSSIAN



Fig 10.

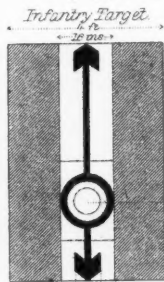


Fig 11.



The targets employed in Austria are of four kinds, viz. :—

1. Target No. 1 (Fig. 1).
2. Target No. 2 (Fig. 1).
3. Target No. 3 (Fig. 3).
4. Figure target (Fig. 4).
5. Group target.

Target No. 1, used for ranges up to 200 paces, is 6 feet 4 inches high by 4 feet 3 inches broad, divided into three portions vertically, the inner one, $18\frac{1}{2}$ inches broad, being left white, and the two others coloured grey. The centre of the "aiming point" *c*, which is painted black, is $40\frac{1}{2}$ inches from the bottom of the target, the point itself being $9\frac{1}{2}$ inches in diameter. Aim is taken at the inferior margin of this point. The oval *a*, is 28 inches long and 14 inches broad, its centre being $20\frac{1}{2}$ inches above the lower edge of the aiming point, the distance above the same that a bullet fired from the rifle at 150 paces with the so-called standing sight, *i.e.*, the back sight adjusted for 200 paces, would strike the target.

Target No. 2 is used for ranges from 300 to 500 paces. It is the same height and breadth as target No. 1. The ground of target is white and the figure, which is 6 feet high, is painted grey. The aiming point is 14 inches in diameter, the oval of the same dimensions as in target No. 1. The lower edge of the aiming point passes through the centre of the oval, *i.e.*, the point aimed at is the centre of the oval, because at whatever range this target is used, the proper sight is employed.

Target No. 3 is exactly like No. 2, except that there is no aiming point. It is used at a range of 300 paces.

The number of points allowed for a hit in the different portions of these targets is as follows :—In the grey portion of the target No. 1, or outside the figures in Nos. 2 and 3, two; in the white portion of No. 1, or in the figures of No. 2 and 3 targets, eight; in the ovals, ten. The aiming point is not taken into consideration in scoring, being used simply to define the point aimed at.

These targets are usually made to pull up and down, or to revolve, in which latter case two targets are arranged like the sails of a wind-mill, so that one at a time only is visible.

The figure target is a coloured representation of a soldier pasted on pasteboard, which is strengthened by a framework. The figure is about 6 feet high and every shot which strikes it counts ten. The figure is sometimes cut down to half, a third, or a fifth of its height to represent a kneeling man, or a man hidden by a shelter trench, &c., for which purpose, also, the head only is sometimes used. Besides the infantry figure target, one representing a cavalry soldier is also employed, and both are used as movable targets, similar to the running deer target.

The group target is used up to ranges of 600 paces and is 6 feet 4 inches high and 11 feet 10 inches broad, with a white ground, on which a number of figures, similar to the infantry figure target, are pasted side by side so as to represent a group. A number of No. 3 targets placed side by side may also be used as a group target.

For shooting at long ranges or for volley firing two of the above targets or six No. 3 targets placed side by side are employed.

The framework of the targets is either of wood or iron, and they may be covered with pasteboard or with linen covered with paper.

The markers' butt is usually sunk in the ground in a trench, 6 feet 8 inches deep, in front of the target, and is provided with a wooden hut covered with earth, on the side of the trench furthest from the target. If circumstances do not permit this arrangement, a simple traverse is used. To communicate between the firing party and the butt, a bell or telegraphic apparatus is used.

Two men are always employed as markers. The position and value of each shot is shown by means of wooden or tin discs, 6 to 12 inches in diameter, affixed to the end of long thin wooden poles. They are differently coloured on each side, viz., white and blue, red and black. The white side is used to indicate a miss, being held on that side of the target by which the bullet has passed. The red side shows a hit in the oval, the black in the figure or in central portion of target No. 1, while the blue is used to indicate the position of a shot hitting in the outer divisions of the same target. To indicate the position of a shot on the figure target, it is lowered and a white disc stuck in the target, by pressing a short stalk with which it is provided into the shot-hole, and the target is then raised to show the soldier.

After indicating a shot, the red disc is shown as a danger signal, while the shot-hole is being plugged, and in the case of a target which pulls up or down, or revolves, while the target is being changed.

It is recommended to have a red and white flag to use as a danger flag for the longer ranges, which one of the markers will carry before the other who leaves the butt to plug the target, retiring after him when this has been done.

The targets employed in France are:—

1. The round target (Figs. 5, 6, 7).
2. The rectangular target (Figs. 8, 9).
3. The small rectangular target.
4. Movable targets.

The first is employed for individual firing up to 300 metres, and is 5 feet in diameter.

The rectangular targets are 6 feet 8 inches high by 3 feet 4 inches wide. Two are placed side by side for ranges from 300 to 500 metres, three are used for 600, four for 800, and five for 1,000 metres.

The small rectangular targets are used to imitate lines of skirmishers, and are 20 inches broad and either 6 feet 8 inches or 30 inches high, according as they represent standing or kneeling men.

The form of the movable targets has not yet been fixed.

On the round target and also on the rectangular targets, vertical and horizontal axes are drawn in black, 2 inches wide. On the round target, when used at 100 metres, a circle is described, 20 inches in diameter; when used at 200 metres one of 40 inches diameter, the border of the circle being in either case 2 inches broad. The shot to count must hit within these circles. For 300 metres the round target

has no inner circle. When the rectangular targets are used at 400 metres, a border is drawn down the vertical edges, 10 inches wide, and all shot to count must strike the target within the borders, *i.e.*, in a space 5 feet wide by 6 feet 8 inches high. At 500 metres the entire surface of the targets counts and no borders are employed.

The framework of the targets is of iron, with a bevelled edge turned towards the shooter to prevent splinters flying back towards the markers. The targets are covered with canvas and white paper.

For signalling, three men are required as markers, with a corporal to superintend. To show a hit a flag of red, or half red half white calico is used, attached to the end of a staff 6 feet 8 inches long. If the flag is raised and kept steady it shows that a hit has been made, but outside the portion of the target which counts. If the flag be waved, it shows that the hit has fallen within the counting portion. If the shot has missed the flag is not raised. To stop the holes a staff 10 feet long is used, with a short arm at right angles to it at one end, which arm carries on the staff end of it an iron disc, colour not stated. The small round of paper used to cover the hole in the target is put over it by means of this staff, which serves at the same time by its disc to show the exact position of the hit.

The shelter provided for the markers is usually a trench 6 feet 8 inches deep in front of the butt, in which, on the side facing the target a wooden hut is provided, roofed in with earth, the exterior side of which must not be more than 5 feet from the foot of the target. One marker attends to the flag, another stops the holes, and the third prepares the paper for this purpose.

The targets in use in the Prussian Army differ very considerably from those employed in the British service. They are of four kinds, *viz.* :—

1. The stroke target (Fig. 10).
2. The infantry target (Fig. 11).
3. The figure target (Fig. 12).
4. The group target (Fig. 13).

The stroke target is 6 feet high by 4 feet wide, white in colour, and having down the centre a black band $4\frac{3}{4}$ inches wide, terminated at its extremities by two arrow heads, which serve as aiming points.

The infantry target is also 6 feet high and 4 feet wide. It is divided into three equal parts vertically, the two outer being painted blue, while the inner one is left white.

From a point on the vertical axis 2 feet from the bottom of the target, with radii of 4, 6, and 8 inches respectively, three circles are described. The smaller of these forms "ring 3," and is marked by a black border about $\frac{3}{8}$ inch wide. The annulus included between the circumferences of the circles described with the radii of 8 and 6 inches respectively, constitutes "ring 1," and is painted black. "Ring 2" is space between ring 1 and ring 3. The space included within the circumference of ring 1 is called the "looking-glass." Above and below it are drawn two black bands horizontally across the central third of the target each $\frac{3}{8}$ inch broad, and with the exterior edges 1 foot distant from the centre of the looking-glass. The space thus included is called the "rectangle." A stroke similar to that on the stroke target,

but only about 2 inches wide, is drawn down the centre line of the infantry target; but is interrupted at the looking-glass.

When the standing sight is used, the target is placed with looking-glass nearest the ground. When flap sight is used, the target is reversed.

The figure target is 6 feet high and 16 inches wide, and bears on it the coloured portrait of a foot soldier. The "rectangle" on the figure target embraces the trunk of soldier's body, and is included within two lines parallel to the top edge, and distant 1 foot and 3 feet respectively from it. The upper fourth of the target is called the "head target," the upper third the "breast target," the upper half the "trunk target," and the two upper thirds the "knee target."¹

The section target is 6 feet high and 8 feet broad. At either side a vertical band 8 inches broad is painted in blue, and the remaining portion of the target is divided vertically into five equal parts, of which the innermost and two outer ones are white and the other two blue.

The targets may be covered with either canvas or cardboard, but the framework is always to be of wood.

In addition to the above fixed targets it is customary to use two varieties of movable target, one in which the target, a figure target, is drawn from side to side, as in the case of the running deer at Wimbledon, at the rate of 120 paces in the minute; the other in which the target is made visible and invisible alternately. The period of visibility is not to exceed that required for twelve paces in quick time.

With regard to the method of marking, the Prussian manual gives but very little information. The signals used must be as simple as possible, and must be made more slowly as the distance increases, the position of each shot being clearly indicated on the target. Before commencing the course, the system of marking is to be practised, and it should also be frequently practised during the course.

If a shot hits—

- a. When the stroke target is used, the stroke;
- b. When the infantry target is used, the target, the white division, the rectangle, or the looking-glass;
- c. When figure targets are in use, the figure or any part of the equipment;
- d. When firing at the section target, the target.

The following must be signalled:—

- a. Stroke.
- b. Target, white division, rectangle, number of the ring. (If a shot strikes between two rings, that with the highest value is to be signalled.)
- c. Figure or rectangle.
- d. Target.

Ricochets are not counted.

When movable or disappearing targets are employed, the former is to be drawn into the middle of the course, and the latter made visible, in order to show the position of the hit.

¹ The figure of a cavalry soldier is also sometimes used.

To signal, a corporal and two men are required for each range, and they are to be changed every two hours.

The organization of the Austrian ranges presents only one point which requires notice, viz., that the men fire from a shed, butts being erected at the various ranges. The French manual gives no detailed information concerning the construction of the ranges. The Prussian instruction book lays down that for a battalion, a range for each of the following distances is required, viz., for 300, 400, and 600 metres. For a regiment of three battalions assembled in one place, two ranges for 600 metres, one for 400 metres, and six for 300 metres, are required. The general construction of these ranges differs in no important particulars from those in use in England, except that great stress is laid on the entire separation from one another of the markers' butts and targets when several of the latter have a common butt behind them, by means of banks of earth.

Having now given a general description of the ranges, targets, and the general method of carrying on the instruction, we will proceed to give a more detailed account of the system of teaching employed in the three Armies.

Austria.

It was formerly the custom in Austria to suspend the course of musketry instruction during the winter months; but a recent order directs it to be carried on throughout the whole year, so that every man may go through at least one. When the cold is very severe, neither Officers or men are to be kept longer than two hours on the range.

The course, for which 110 rounds of ball cartridge are allowed for Officers and men alike is divided into:—

1. Preliminary drill.
2. Judging-distance practice.
3. Class shooting.
4. Practice shooting.
5. Field firing.

The Officers receive the same instruction as the men, and especial stress is laid on their target practice which takes place once a week during the fine weather. The preliminary drill is of a similar character to that which obtains in England. The soldier is taught to aim, in the first instance, from a rest, the instructor testing the accuracy of his aim, and afterwards he practises independently. The object aimed at at first, is a small black circle of 1 to 2 inches diameter, later on, the proper targets are used at the regulation distances. It is also recommended to make the recruit aim at the eye of the instructor. Position drill is taught standing, sitting, kneeling, and lying down. Instruction is also given in aiming from behind trees, and in aiming at objects, moving sideways, or to or from the soldier. Aim is always taken with a full sight, and half way up the object fired at. In firing at moving objects the soldier is taught to aim, when the object fired at is moving at the ordinary marching pace:—

If 100 paces distant 1 foot in front of it.

If 150 " 1½ feet in front of it.

If 200 " 2 " "

If a cavalry soldier, moving at a gallop, is to be fired at, the soldier aims when he is 150 paces off 3 feet in front of the horse's chest; 300 paces off, 6 feet in front of the horse's chest.

Against objects which are moving to or from the soldier, the latter will aim as a rule at the mid-height as long as the distance permits the standing sight to be used. At longer ranges he will aim somewhat under or over the mid-height as the object is approaching to or retiring from him.

The recruit is taught to fire by a steady pressure of the trigger while holding his breath, and is instructed to keep the rifle at the "present" for three pauses of quick time after firing, and to observe the direction of rifle at that moment. In order to ensure a proper method of pulling the trigger, the instructor is recommended to lay his own forefinger on the soldier's, and to fire the rifle himself without the aid of the former.

Judging-distance practice is to be taught to the soldier, so that he may be able to judge as accurately as possible all distances within the range of his rifle at least up to 400 paces. Officers and non-commissioned officers must be able to judge distances up to 1,200 paces with accuracy.

At the commencement of the instruction, soldiers are to be placed at intervals of 100 paces, one behind the other, but so that all are visible from the point where those who are to be taught are drawn up. The attention of the soldiers is then drawn to the apparent length of the first hundred paces, and also the apparent decrease in each subsequent hundred paces due to its distance from the observer, and they are told to impress these appearances on their memories, with a view to applying them to judge ranges. They are further to observe the appearance of the men at the different distances, and to note what portions of their bodies and of their arms and equipment are visible at each.

When the soldier has made a certain amount of progress in judging distances on the flat, he is to be further instructed on rough and uneven ground, and to estimate the distances of soldiers partly behind cover and fully exposed. He is also to be taught how the period of the day, the nature of the lighting, and the various atmospheric influences affect the question. Thus objects seem nearer the better they are lighted, the larger they are, the lighter their colour, or the darker the background against which they stand, the purer the air, the more uniform the tint of the ground between them and the observer. On the other hand, they appear farther off when looking towards the sun, and *vice versa*. The clear cold air in winter or after a thunderstorm, makes objects seem nearer, while fog, powder-smoke, or the vapour caused by the heat of the sun, makes them look further off. A smooth expanse, as fields covered with snow, corn-fields, or water, has the effect of rendering the distance apparently shorter. Ground falling towards the object has the same effect, and the contrary when it rises.

The number of men forming a firing squad is not to exceed 15, under the command of an Officer or a non-commissioned officer, with a bugler or drummer.

After having posted the look-out sentries, and seeing that the targets

and markers' butts are in proper order, the arms are to be inspected. The bugler will then sound the call "Commence firing," or the drummer give a "complete roll" (*ganze ruf*, i.e., a roll of a certain length), and the markers retire behind the traverse or into the hut, removing the signalling disc, which hitherto should have been placed against the target with its red side outwards.

The name of the first man is then read out by the Officer or non-commissioned officer in charge of the squad from the previously prepared register with which he is provided. The man named steps to the front with his rifle at the short trail or shouldered, loads, taking care to keep the muzzle towards the target, aims, and fires. If he finds any difficulty in aiming he comes down from the present, rests a moment or two, and then aims again.

While the man has his rifle at the present he is not to be corrected or disturbed in any way. In the case of beginners or untrained men, they may be ordered to come down to the loading position, and then their faults shortly pointed out to them.

After firing, the man extracts the cartridge-case and comes down to the shoulder or short trail, calling out at the same time where he thinks he has hit the target, and then waits till the shot is signalled. In case the men find any difficulty in doing this, it is recommended that the Officer or non-commissioned officer in charge of the party should have a plan of the target in use drawn out on paper, on which each soldier can point out the place where he believes his shot has struck.

When the shot is signalled any remarks on it which are necessary are to be made, and the soldier then falls back, and places his rifle against the rack, after seeing that his shot is properly registered.

Where the butts are not provided with markers' trenches, but only with traverses, the next man is not to be called to the front until the markers on the range concerned, and any neighbouring ones, have retired behind the traverses.

After each shot has been fired, the marker is to be informed by means of the telegraph or bell, or, where these do not exist, by a single note on the bugle or a short roll on the drum. If the value of the shot is to be re-indicated, that one of these signals which is in use must be given again.

After each soldier has fired five shots, the total value of them is to be carried out on the register. When firing at the disappearing or movable target, the soldier is not to load till the signal has been given to the marker to make the target visible.

To facilitate the observation of the direction of the wind, a flag should always be put up in a suitable position before the firing commences.

When the practice is concluded the arms must be inspected before marching the party off, to see that no rifles are loaded.

Empty cartridge-cases are to be allowed to fall on the ground when extracted, and are to be picked up by men told off for this purpose and to attend to the marker's bell or telegraph. On no account are they to be placed in the pouches, where they would be likely to damage the other cartridges.

The *class shooting* is conducted as follows, the position being standing.

The 3rd class embraces those soldiers who shoot for the first time, or those who in previous courses have not obtained a score entitling them to be placed in the 2nd class.

The 3rd class course commences with the target No. 1 at 150 paces (125 yards). As soon as the soldier in a series of five consecutive shots has scored 30, the range is increased to 200 paces (166 yards), and when he has, under like conditions, again scored 30, he shoots at targets No. 2 and No. 3 at 300 paces (250 yards). When he has in the same manner scored 30 at 300 paces with No. 3 target he is transferred to the 2nd class. The practice of the 2nd class shots is carried on at 400 paces (333 yards) against No. 2 target. When the soldier has in two consecutive series of five shots scored 30 in each series, he is promoted to the 1st class.

First class shots, called marksmen (*schützen*), have no course of class shooting. Of the 110 cartridges allowed annually for each soldier, the 2nd and 3rd class shots use 70 for the class shooting.

Practice shooting.—Third class shots do not go through this course unless they have arrived at shooting at No. 2 target at 300 paces without expending more than 70 cartridges. When this has been done they use 10 cartridges, firing in the different positions likely to be made use of in war at the whole-figure target (the Rifle battalions using also the half-figure target) at 150 and 200 paces. The back sight is set for 300 paces for the whole-figure, and for 200 for half-figure target.

Second class shots use 10 cartridges in firing at 200 paces at the whole-figure target, and at the half- (in the case of the Rifle battalions the one-third-) figure target at 150 or 200 paces. The back sight is set as above described for the 3rd class shots.

Seventy cartridges are employed by the marksmen in practice shooting. They fire five shots at the whole-figure target at 200 and 300 paces, and again at the disappearing target¹ at 200 paces. At the one-third and one-fifth figure targets at 150 and 200 paces, and at the head target at 150 paces. At the moving whole-figure target up to 200 paces, and the moving cavalry soldier target up to 300 paces. At No. 2 target up to 500 paces, and at the group target from 600 to 1,200 paces.

When shooting at the one-fifth figure target the back sight is to be set for 200 paces, and when aiming at 150 paces, the lower edge of the target is to be aimed at. When shooting at the head target the aim is to be taken half the height of the head below the target.

Those soldiers who, in the course of the class shooting, have reached the 1st or marksmen's class, are to be put through the course of practice shooting laid down for the 2nd class; any spare ammunition they may have over from the class shooting, through becoming marksmen without expending the allotted seventy rounds, will be used by them in practice shooting under the conditions laid down for their class.

Field Firing.—This portion of the musketry instruction is divided

¹ See page 917.

into two parts, called respectively, "shooting by classes" (*klassenweise-schiessen*) and "united practice" (*gesammtübung*).

The shooting by classes is intended to instruct the soldier in the proper way to use his weapon in the modern shooting line. For this purpose the men are practised in all the incidents of a fire fight, advancing and retiring, for the 3rd class shots, up to 300 paces; for the 2nd class, up to 400 paces; and, for the 1st class, up to 600 paces.

The targets used are a section target, 12 feet 8 inches wide (see *ante*, p. 897), in addition to which a few figure targets are placed in front and at the side of it. The latter are whole targets for the 3rd class, half targets for 2nd class, whole, half, and one-third figure targets for the 1st class. Fifteen cartridges are allowed for this portion of the course, and it is recommended that they should not be expended all on one occasion, but should be spread over several. Further, great stress is laid on making it as real as possible. Every kind of ground should be made use of and, if possible, some of the targets should be arranged to appear and disappear.

The united practice is similar in character, but all three classes are united for it. It embraces the carrying out of an action, by a shooting line, advancing and retiring up to 600 paces (500 yards), for which five rounds are allowed, and further, the delivery of volleys and independent firing, from closed bodies up to distances of 400 paces (334 yards) for which ten rounds are allowed. The targets employed are the same as in the shooting by classes, except that the section target is 25 feet 4 inches wide. As a rule, it is laid down that the marksmen should open fire first, at the longer distances, and should aim at the smallest targets.

When ammunition is available, and circumstances permit, it is recommended to carry out this part of the course with bodies of troops on a war strength, up to that of a battalion, if possible, and under all the conditions of actual warfare, of which some simple "special idea" should form the basis.

With regard to uniform for class shooting, it is laid down that "the "greatest possible comfort in attire should be permitted," but for practice shooting and field firing, the soldier should be in service order.

As a distinctive mark, the marksmen wear a scarlet (grass green for riflemen) breast-knot on the left breast. Besides this, prizes are given to those who make the best scores in the annual competition laid down for them. For this purpose the 1st class shots of one or several companies shoot together, at a No. 2 target at 400 paces, a series or, if possible, two series of five shots, the prizes being given to those who make the best scores. No details are given as to the nature of the prizes. The soldiers of the 2nd and 3rd classes have to be present at this competition.

No special report is made to the authorities on the course of musketry instruction, but, at the end of every year, the average results of the various portions of the course are struck, and these serve, if necessary, as a means of comparison between regiments, and show, at the same time, what progress has been made.

France.

The system of musketry instruction in France differs a good deal from that employed in Austria. The general principles on which it is carried out have already been described, and we will now proceed to give a short sketch of the manner in which the instruction is imparted.

To ensure proper knowledge on the part of the subaltern Officers, the non-commissioned officers, and corporals, a regimental school of instruction is organized annually, during the last three months of the year. The course includes a thorough knowledge of the "*Manuel de l'Instructeur de Tir*," of the method of preserving and cleaning the arms, numerous exercises in judging distances, with the theoretical and practical application of all the different methods of doing this.

The lectures are given to the subaltern Officers by the Captain-Instructor and the battalion instructors to the non-commissioned officers and corporals of their respective battalions. At the termination of the course, the Colonel of the regiment, assisted by the Lieutenant-Colonel and the Majors commanding battalions, examines those who have been through the course. He dispenses with the future attendance of those Officers who show a complete theoretical and practical acquaintance with the subject, setting them instead every year, a subject for an essay bearing on the question of musketry instruction, taking care that it is of a practical or novel character. He will also give the preference for promotion to those non-commissioned officers and corporals who make themselves conspicuous by their zeal or their aptitude for instructing.

The inspecting General will further complete this measure by striking out from the promotion lists the names of all who are not in possession of musketry certificates. These are to be obtained in accordance with the instructions laid down annually by the Minister of War.

Great stress is laid in the manual on the necessity of being a good judge of distance. The soldier ought to be able to estimate the distance of the enemy up to 800 metres (875 yards); the Officer should be able, with the aid of a field-glass, to do so up to 1,000 or 1,200 metres (1,093 or 1,312 yards).

The method of instructing in judging distance is as follows:—The soldier is first to be taught the relation between his ordinary pace and the metre. To do this it is recommended that a length of 100 metres should be laid down in the barrack yard or other convenient place, subdivided into spaces of 10 metres, or having at least one such division marked, and that the men should be frequently made to pace it to ascertain the relationship between their pace and the metre for themselves, both for the whole distance and for the length of 10 metres. The exactitude of this system will then be impressed on the soldier by frequent measurements on other ground.

Being thus able to measure distances by pacing, he will now be taught to do so by sight. For this purpose, men are posted in couples, at 200, 300, 400, and 500 metres. One of them remains steady while the other, standing about 5 paces from him, goes through the usual motions of a man skirmishing before the enemy.

The Instructor then draws attention to the different parts of a soldier's uniform and equipment visible at the various distances, and teaches them to make these observations for themselves, and also as to what portions of the body are clearly distinguishable at the different ranges. They are also to be taught that the height of the foresight, above its base, covers, when the rifle is at the present, half the height of a soldier at 200 metres, and his total height at 400 metres.

When the whole squad understands the above rules, the Instructor will send a man in a different direction, and the men will then be told to estimate the distance, and each man will set his sight at what he estimates to be the proper range. The actual distance will then be measured by pacing, and when it has been ascertained, the Instructor will communicate to the men the elevation that should have been used. Beyond 600 metres (700 yards) it is necessary to send out the men by fours, as the difficulty of estimating the range at such distances from the appearance of one man only is very great.

Judging-distance practice is to be carried out over all kinds of ground, in all weathers and at all times of the year, and it is to be carefully impressed on the men how useless the fire of an individual man is, unless he is capable of estimating correctly the distance which separates him from the object aimed at.

The commanders of battalions are to instruct their Officers in judging distances up to 1,000 or 1,200 metres (1,093 or 1,312 yards) with the aid of field-glasses. When marching out, the opportunity is to be taken advantage of for practising this portion of the course. A few men may be sent out to fire blank cartridges to permit the estimation of distance by means of acoustic telemeters, such as that of Le Boulangé and others.

In the field, distances may be estimated by preliminary volleys, by telemeters, or may be got from maps or from the artillery if any be near at hand. It is better to use too little than too much elevation, and in settling what height of back sight is to be employed, the state of the weather must be taken into consideration. When on the defensive, if time permit, the distance of all important points should be ascertained and marked with cairns of stones, bunches of straw, or other simple means, taking care to arrange them so that they will not benefit the enemy.

The course of instruction exclusive of judging distance is divided into—

1. Aiming drill.
2. Position drill.
3. Target practice.

Aiming drill is taught on the same lines as with us.

The man commences by aiming his rifle placed on a sandbag on a tripod at a mark $\frac{3}{4}$ inch in diameter about 11 yards off. He aims with a full sight so that the top of the fore sight just touches the bottom of the circle. The rifle is at first aimed by the instructor, the men forming the squad looking along it in succession to see how it is done, and afterwards they are taught to aim themselves.

To show graphically to the men how easy it is to make mistakes in

aiming, the following exercise is next to be carried out. A rifle is placed on a sandbag rest and directed at a large piece of paper pasted on a board or at a target without aiming point. A man is provided with a small disc of iron $\frac{3}{4}$ inch in diameter at the end of a long wire, which he moves about the target till the man who is aiming, and who directs his movements, thinks it is in the line of sight. When this is the case he calls out "mark," and the instructor then marks the point aimed at by making a dot on the target by passing a pencil through a hole made in the centre of the disc for the purpose. The operation is repeated three times and the resulting three dots joined so as to form a triangle, which may be called the triangle of error of the particular individual.

When this has been done for one man the rifle is directed on another part of the target and the process is gone through again by another, and so on.

The next step is aiming with the sight set for 200, 300, and 350 metres, and the explanation of the graduations up to the extreme limit, 1,800 metres. The soldiers are also to be taught to make the necessary allowances for wind, or for any permanent deviation peculiar to their own particular weapons.

After this, the relative position of the line of fire and the line of sight is shown to the men by removing the breech-block, with a view to their understanding the part played by the back sight in aiming at the different ranges.

Position drill is then commenced. The man is taught to bring his rifle up properly, the instructor placing it in his shoulder. When this has been done the man himself brings his rifle to the present without aid, aiming at the same time. He is taught always to aim with the top of the fore sight part touching the bottom of the object aimed at, at the belt when firing at a man standing, or the bottom of the circle forming the aiming point on a target.

The man aims with the sight set for different ranges between 300 and 600 metres first of all, and afterwards for those over that range.

Part of the aiming is to be at the eye of the instructor so that he may be able to point out any errors.

When the men have learnt to aim standing, they are taught to do so kneeling and lying down.

The next step is to teach them to fire properly. This is done at first without cartridges, and then with blank cartridges before the target practice is commenced.

The man is taught, as far as possible, to note the point he was aiming at when he fired.

A common fault in firing is to move the shoulder at the moment of pulling the trigger. This can be ascertained by mingling with the ball cartridges supplied to the suspected man, one or two from which the powder has been removed.

Target practice is divided as shown in the table given below, which also shows the number of cartridges allowed and the manner of expending them.

No. of Practice.	Range.	Nature of the Practice.	No. of cartridges.		Remarks.
			Blank.	Ball.	
1	100 m. (110 yds.) ...	Preliminary drill... ..	6	6	For all three classes.
2 and 3	200 m. (220 yds.) ...	Individual firing ... ..	...	12
4 and 5	300 m. (330 yds.) ...	" " one standing, one kneeling ... ..	...	12
6 and 7	400 m. (440 yds.) ...	" " one standing, one lying down ... ..	...	6
8	500 m. (550 yds.) ...	" " kneeling ... ..	...	6
9	600 m. (660 yds.) ...	" " " or lying down ... ..	...	6
10	200 m. (220 yds.) ...	" " " " ... ..	...	6
11	800 m. (880 yds.) ...	Lying down	10	B For 1st class only.
12	1,000 m. (1,100 yds.) ...	Kneeling ... ..	...	10
13	To be fixed by the Colonel.	Kneeling at a moving target ... ..	...	10
11	Short distances to be fixed by the Colonel.	Lying down	10	A For 3rd class only.
12		Standing ... ..	...	10
13		Lying down or kneeling ... ..	...	10
14	...	Skirmishing	10	10
15	To be fixed by the Colonel.	Squad volleys, commanded by a corporal	2	5	For all three classes.
16		Volleys in half-sections, commanded by a sergeant	2	5	
17		Volleys in sections, commanded by a section-leader	4	10	
18		Company independent firing, commanded by the Captain	3	5	
19		Volleys by companies, commanded by the Captain	3	5	
			20		

The musketry instructors place the targets, which must be put at intervals from one another, equal to at least twice their breadth. They are responsible for the general security and order on the range. They must also ascertain any corrections that the wind or weather may necessitate in aiming, by shooting with a rifle of a perfectly normal character before the men commence their practice.

Before the firing begins, the musketry instructor will order a drummer to beat a roll, or the trumpeter to sound the "alarm." The markers then wave their flags to show they hear it. When the signal "commence firing" is given on the drum or trumpet, the markers lower their flags. To stop firing, the "cease fire" is sounded or a roll given on the drum. The markers will then raise their flags. When the signal "rise" is given, the markers may leave their butts and not before. When the ranges are not sufficiently long to permit the whole of the practices laid down for individual firing to be carried out, the series will begin again from the beginning as often as may be necessary to expend the sixty cartridges.

When independent firing or volleys cannot be practised, the cartridges allowed will be expended in individual firing.

If a man has been absent from more than one of the individual firing practices, he will begin the series again from the commencement.

At the ranges the men will be divided into sections or half sections according to the number of the targets.

The section which is about to fire is drawn up ten paces from the firing point, those waiting their turn twenty paces to the rear. The markers, who are not to mark for their own companies, are to be chosen from the waiting sections.

The non-commissioned officers fire first and then the men, beginning from the right of the squad. Each man advances, makes ready, and fires. He discharges his six cartridges one after another, calling out the result of each shot after it has been signalled. After he has finished, he retires by the left flank and falls in five paces in rear of the right flank of the section.

The other men follow in succession.

A non-commissioned officer is posted close to the firing point, whose duty it is to keep the shooting register and see that the man fires properly.

Each time that a hit which counts is signalled, the drummer gives one tap on the drum, or the trumpeter one note on the trumpet.

Although ricochets count, still when the instructor observes that one has been made, he should point out, if possible, the cause of this error to the man shooting.

The execution of *skirmishing fire* takes the place with the French of the field firing of the Austrians and Germans, for which purposes, says the "Manuel," "it should be executed under circumstances resembling reality as much as possible."

The targets should represent a skirmishing line with supports and reserves also if possible. The skirmishing line is represented by the small rectangular targets placed 7 feet 6 inches from centre to centre. The supports, 150 metres (165 yards) in rear of the former, will be represented by two targets, each of which is to 27 feet 8 inches wide,¹ placed side by side or separated. Nothing is laid down with regard to the targets for the reserves, it being but very rarely that these can be employed owing to want of space and the necessary materials.

The ranges will always be unknown to the men. The usual manner of carrying out this part of the course will be to extend the company at 700 to 800 metres (770 to 880 yards) from the first line of targets, towards which the men will then advance, and retire firing between 600 and 400 metres (660 and 440 yards).

All ranges are not suited for this particular exercise as here laid down. It must then be modified according to circumstances; keeping always in mind its object to represent the various phases of an infantry fight.

In *volley firing* the squad is formed in single rank. All the other formations are in two ranks.

The ball firing is preceded by the regulation number (see table, p. 909) of rounds of blank cartridge. Stress is laid on the volley being given together. The Officers or non-commissioned officers in charge are to be careful not to delay too long or to hurry the time between "present" and "fire." They determine also the elevation to be used,

¹ The height is not given.

the volleys being always delivered at unknown distances. In the *independent firing*, practice No. 18, care must be taken that the men adjust the back sights as ordered, that they aim properly and do not fire too quickly. The same targets are used for this and volley firing as for skirmishing.

The men are divided into three classes according to the results of the individual firing. Those who have struck the targets thirty times to count, form the 1st class, those who have hit twelve times, the 2nd class. The 3rd class embraces the rest of the men. Men who have not completed their course by one or two practices, are classed according to their scores.

After going through the course as described, the 3rd class shots are put through the course marked B in the table, the 1st class shots through that marked A. The 2nd class shots are again put through the preliminary instruction and fire at short distances.

With reference to the further instruction of the 1st class shots, it should, if possible, include practice in plunging fire. This can only be carried out at a range of 800 metres (880 yards) and over. The slide of the back sight should be set one millimetre (.039 inch) above the proper height to ensure the projectile clearing the crest of the object behind which it is desired to obtain effect.

The ammunition for this purpose is to be obtained from the surplus arising from men not going through the whole of the course.

In aiming at moving objects, the soldier should be taught that to hit a cavalry man moving at the walk, trot, or gallop, at a range of 600 metres (660 yards) it is necessary to aim 3, 7, or 11 metres (10, 23, or 36 feet) in front of the horse.

Nothing is laid down as to the dress to be worn at any part of the course.

After the annual musketry course is finished, competitions take place between—

1. The non-commissioned officers.
2. The ten best shots, corporals or soldiers, of the several companies, determined by the individual shooting.
3. The companies.

The first two take place at 200 metres (220 yards) against the round target. Six rounds are fired by each man excluding three sighting shots if he likes to have them, and the mean deviation of the six from the centre of the target is measured, the man who makes the smallest string winning. Ties fire a seventh shot to decide.

For the companies the target used is plain white, 13 feet 4 inches long by 6 feet 8 inches high. It is placed at 600 metres range (660 yards) if possible, if not at as long a range as it can be.

Six rounds are fired in volleys, the total time taken being noted and the figure of merit calculated by the useful effect, which is calculated thus: If 128 hits have been made by 85 men in 78 seconds, the useful effect, *i.e.*, the number of hits that would have been at that rate and accuracy in one minute by 100 men, is $\frac{128 \times 60 \times 100}{85 \times 78} = 116$ nearly.

As badges for the corporals and men, a grenade in gold, to be worn as a decoration, and fifty-four badges (French horns) in yellow cloth are given to each regiment annually. Each independent battalion receives a grenade and fifteen badges. For the non-commissioned officers, a grenade and nine badges in gold are given to each regiment, and a grenade and three badges to each independent battalion. Men who obtain a cloth badge two years running have it changed into one in gold, provided they are in the first half of those who receive badges. First class shots who win a golden badge are called marksmen (*tireurs d'élite*). They do not take part in the annual competitions unless the result of the individual firing place them among the first ten. If they then again win a badge it is noted in their pocket books; but the badge is given to the next on the list.

The twenty best shots of each regiment including these non-commissioned officers receive a certain amount of furlough, determined each year by the War Minister, provided they are not otherwise undeserving of it. From each independent battalion six men including one non-commissioned officer receive like furloughs.

For the information of the War Minister a report on the musketry instruction of each regiment is rendered annually.

It is divided into three parts, the first two of which are compiled by the Colonel of the regiments, the third containing the remarks of the General Officers commanding brigades and divisions on the first two.

The first part deals with the organization and results of the regimental school of instruction, gives the names of the instructors of musketry and reports on their zeal and qualifications, and also opinion of the Colonel as to the methods of instruction and the results obtained, &c. The second part contains detailed information as to the result of the individual, volley, and skirmishing firing, with explanatory notes when necessary. The report must be despatched before the 15th January of each year.

Prussia.

The course of musketry instruction in Prussia presents many points of difference as compared with those of the other two countries, some of which are specially worthy of remark.

As has been previously stated, the instruction of the men is placed almost entirely in the hands of the Captains of companies, the junior Officers of course assisting. To ensure that the company Officers have a proper acquaintance with their work, the regimental and battalion commanders are ordered to make themselves thoroughly acquainted with their attainments, and the company chiefs are to bestow similar attention with regard to the knowledge possessed by the non-commissioned officers under their command. Those engaged in instructing the men are to practise with each other in order to keep up their knowledge and power of teaching. The Captains and Subalterns of each battalion or regiment are, if possible, united each year to go through a course of class shooting, under one of the senior Officers told off for this duty, in which they have to fulfil the same conditions as the men. Any Officers who may belong to the regiment, but who are detached

from it for staff duty in the same garrison, are to be recalled for this purpose.

The whole of the non-commissioned officers go through the course of rifle shooting with their respective companies.

The course may be divided into—

1. Preliminary drill in position and aiming.
2. Class shooting.
3. Field firing.
4. Instruction practice.

The recruit is to have a rifle placed in his hands as soon after he joins as possible in order that he may get quickly accustomed to it. His instruction in its use commences with aiming drill. For this purpose the rifle is placed on a sand bag or in an aiming apparatus¹ (*ziel machine*), and aimed by the instructor. The man then looks along the rifle, and sees how the aim is taken with reference to the sights, &c.; and when he understands how this is done, he aims himself at first from some rest, as above described, afterwards without support. The various errors which may be made by the man such as inclining the sights to one side, not having the fore sight in the centre of the notch, taking too fine or too full a sight, not having the fore sight in the centre of the notch of the back sight, &c., are to be duly pointed out. At the same time, the man is taught to grasp the small of the butt properly so as to be able to pull off the trigger in the right manner. The proper method will be shown to him by the instructor placing his own finger on the man's, and pulling the trigger.

Position drill is to go on simultaneously with aiming drill. It is carried out on the same principles as in England.

When sufficient progress has been gained in position and aiming drill separately they are to be combined, and the man taught to aim properly in the proper position. For this purpose a rest is at first employed. No definite pattern is laid down in the regulations; but a good one is said to be that of an inclined table with steps on which the elbow can be rested. In using this apparatus care is to be taken that the rifle only rests lightly on the table, and that the proper position of the body is not departed from.

When the recruit has been sufficiently taught by this method he will be practised in aiming without a rest in the various positions, such as kneeling, sitting, lying down, behind a tree, &c., and also at moving objects. He is not to be allowed to begin ball practice until he has made sufficient progress in the preliminary drill.

Before firing with ball cartridge, of which 130 rounds are allowed annually for every company Officer, non-commissioned officer, and private, and 50 rounds for each Field Officer, the soldier is to be practised with blank cartridge, 30 rounds of which are allowed per man annually. The rest is to be employed, and aim always taken at a target.

A very common error in shooting is closing the eyes while firing. To prevent this it is recommended to hand occasionally to the man an

¹ No information is given in the instruction book as to how the sand bag is supported, or what the nature of the aiming apparatus is.

unloaded rifle, so that he may be in ignorance as to whether there will be a recoil or not. This should be done not only during the practice with blank cartridge, but also during the target practice.

When ball firing is begun particular care is to be paid to the attitude of the soldier. If the instructor sees that he is aiming badly or that his position is not right, he is at once to correct him before the shot is fired. Such corrections should, however, be quickly and quietly done, so as not to fatigue the man by keeping him too long at the present.

If the man is unsteady in aiming, he is to be ordered to come down from the present and rest for a few moments. If the unsteadiness continues his practice may be deferred to a future day, or he may be put back to a shorter range by the special order of the company chief.

After firing, the weapon is to be kept at the present for a short pause, and then brought down in the man's own time, and the latter is then to state the point at which he was aiming at the moment of firing.

If a bad shot is made the instructor is to point out, as far as possible, the reason of it.

In aiming at moving objects the left hand alone is to be used to move the rifle. The more distant the object is, or the farther it is off, the farther in front of it must the aim be taken. Thus, in the case of the drawing target, if this be moving in ordinary quick time at 100 metres distance, the aim must be taken 8 inches in front, if the range be 150 metres, 24 inches in front of it.

To make proper use of the rifle in the field, it is necessary that the men should be able to aim quickly, choose the proper point to aim at with reference to the field of fire, and make proper use of natural objects to support the rifle and to give them cover from the enemy. Further, it is needful to be able to judge distances quickly and accurately in order to arrange the back sight properly. To keep up the requisite amount of skill in all these branches of the art of shooting they must be frequently practised during the whole period of the soldier's service.

The target practice is to be conducted in easy dress,¹ so far as the preliminary practice of each class is concerned. The main practice, however (*Haupt Uebung*), is to be carried out in marching order with knapsacks packed. In order to accustom him to the different movements of the rifle in marching order, it is laid down that position drill should be practised by him when fully equipped, and before he commences the course of ball practice or field firing.

The men, when going through the class shooting, are not to be tired out by long marches to and from the range, or by fatiguing work beforehand. They are not, as a rule, to fire more than ten or less than five shots at one practice.

If during the course it is discovered that certain men are short sighted, their instruction may be limited to those ranges at which their sight permits them to shoot with effect.

When a man fails in twenty consecutive shots, whether fired on the same or on more than one day, to hit the target four times, he is to be put back to the next shortest range, and especial attention given to him.

¹ *Bequemer anzug*, with belt, one pouch, and forage cap, equivalent to drill order.

If it appears in the course of ball practice that certain men are not likely to improve in their shooting, and that therefore a continued expenditure of ammunition by them would be waste, they may be at the discretion of the battalion commander excluded from taking any further part in the course.

The use of tents or other means of shelter for the men on the range, any alteration of the targets, or the use of anything by which the conditions of the course are altered in a sense unfavourable to the proper preparation of the soldier for war, is absolutely forbidden.

The field firing is to be carried out on ground specially chosen for the purpose, and is only to take place on the ordinary ranges when no other arrangement can be made.

The ammunition required for field firing, thirty rounds per man, is to be set apart for that purpose from the annual allowance as soon as received. Any ammunition there may be to spare after the courses of class shooting and field firing have been gone through is to be devoted to instruction shooting, to the further instruction of the bad shots, and the improvement of the best shots.

When shooting is going on, the following precautions are to be observed :—

The battalion commander is to tell off an Officer, whose special duty it will be to take charge of the ranges and to see that the prescribed precautionary measures are observed. He is to be assisted by a non-commissioned officer detailed for the purpose, and who is to have control over the arms, the ammunition, the lead recovered, the cartridge cases, &c., and to take charge of the rests, aiming apparatus, and target stores. Arms are to be inspected before leaving barracks, before shooting and after. At the end of each practice the pouches are also to be inspected. No rifle is to be left loaded when out of the man's hands. When arms are piled the breeches are to be open.

The markers when leaving the butt are to do so slowly, holding the red and white danger flag in front of them. After plugging the shot-hole they are to retire as quickly as possible, the flag-bearer last.

Signals on the bugle and drum are only permitted when movable targets are employed, and then only to serve as signals for the markers to set the targets in motion or make them visible.

Special precautions are to be taken for the safety of the markers and spectators during field firing. If no convenient positions for the markers are to be found near the targets they must be withdrawn to the men shooting. Practice is not to be carried on at more than one target on the same range.

The following *personnel* is required on the range during practice in addition to the markers. An Officer to generally superintend, a non-commissioned officer to give out the ammunition (these two are to be those specially detailed by the battalion commander previously alluded to), another to attend to the loading, whose immediate duty is to see that the men do not load till the markers have retired to their butts, and a third to write down the results in the shooting registers.

The men are to be marched to and from the ranges. Each squad, not exceeding five in number, is to be drawn up in single rank facing

the target. When the markers retire behind their butt, the man whose turn it is to fire, steps to the front and loads. It is not laid down whether he then fires or waits for the word of command.

After firing, he waits till the shot is signalled, calls out his name, and where he has struck the target, and then steps back again.

Each soldier is provided with a small book, in which the results of his shooting are entered as well as in the company register. Further, when going into the reserve, it is noted on his papers what class he belongs to, &c.

Class Shooting.—Officers, non-commissioned officers, and men are divided into three classes—1st, 2nd, and 3rd class. A further class is formed of those Officers and non-commissioned officers who have twice fulfilled the conditions of the 1st class. It is called the special class, and the conditions for class shooting in it are to be specially laid down by the battalion commander.

For promotion from one class to another, the necessary conditions must be fulfilled in the last five consecutive shots. Thus if a soldier fires eight shots he must obtain the necessary score in the fourth to the eighth, i.e., the last five shots.

The accompanying table shows the conditions required to be fulfilled by the various classes:—

No. of practice.	Range.	Position.	Target.	Sights to be used.	Conditions to be fulfilled.
THIRD CLASS.					
1	100 m. (110 yds.)	Standing, with rest.	Stroke target.	Standing sight.	5 hits, of which 2 in the stroke.
2	"	" "	"	"	5 hits, of which 3 in the stroke.
3	"	" "	Infantry target.	"	5 rectangles, of which 4 looking-glasses.
4	"	Standing, without rest.	"	"	5 rectangles, of which 2 looking-glasses.
5	150 m. (165 yds.)	Standing, with rest.	"	"	5 hits, of which 4 in central third of target, 3 rectangles, 2 looking-glasses.
6	"	Standing, without rest.	"	Flap sight.	5 hits, of which 3 in central third of target, 2 rectangles, 1 looking-glass.
7	"	Kneeling.	Figure target.	"	3 hits in figure, 2 of them rectangles.
8	"	Lying down, rifle supported.	Trunk target.	Standing sight.	3 hits in figure.
9	200 m. (220 yds.)	Standing, with rest.	Infantry target.	"	5 hits, 3 in central third, 2 of which rectangles.
10	"	Standing, without rest.	"	Flap sight.	5 hits, 2 in central third, 1 of which rectangle.
11	"	Lying down, rifle unsupported.	Figure target.	"	2 figure hits in figure.
12	"	Lying down, rifle supported.	"	"	3 figure hits in figure, 2 of them rectangles.
13	400 m. (440 yds.)	Kneeling.	Section target.	450 metres.	3 hits.
14	150 m. (165 yds.)	Standing, without rest, 5 shots at word of command	Infantry target.	Flap sight.	4 "

Preparatory practice.

No. of practice.	Range.	Position.	Target.	Sights to be used	Conditions to be fulfilled.
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SECOND CLASS.

1	100 m. (110 yds.)	Standing, with rest.	Stroke target.	Standing sight.	5 hits, of which 3 in stroke.
2	150 m. (165 yds.)	" "	Infantry target.	"	5 hits, 4 in rectangle, of which 3 looking-glasses.
3	"	Standing, without rest.	"	Flap sight.	5 hits, 3 in rectangle, of which 1 looking-glass.
4	"	Lying down, without rest.	Trunk target.	Standing sight.	2 hits in figure.
5	"	Standing, without rest.	Infantry target in motion.	Flap sight.	5 hits, 2 in central third.
6	200 m. (220 yds.)	Standing, with rest.	Infantry target.	Standing sight.	5 hits, of which 4 in central third, 3 of them rectangles, of which 2 in looking-glass.
7	"	Lying down, without rest.	"	Flap sight.	5 hits, 3 in central third, 1 of which rectangle.
8	"	Kneeling.	Knee target.	Standing sight.	2 hits in figure.
9	250 m. (275 yds.)	Lying down, without rest.	Infantry target.	Flap sight.	5 hits, of which 2 in central third.
10	"	Lying down, with rest.	Figure target.	"	3 hits in figure.
11	500 m. (550 yds.)	Kneeling.	2 section targets together on their sides.	550 metres.	3 hits.
12	200 m. (220 yds.)	Kneeling, 5 shots at word of command.	Infantry target.	Flap sight.	4 "

Preparatory practice.

FIRST CLASS.

1	100 m. (110 yds.)	Standing, with rest.	Stroke target.	Standing sight.	5 hits, 3 consecutively, or 4 in stroke.
2	150 m. (165 yds.)	" "	Infantry target.	"	5 hits, of which 5 in central third, 4 of them rectangles, 3 of these in looking-glass.
3	"	Standing, without rest.	"	Flap sight.	5 hits, of which 4 in central third, 3 of them rectangles, 1 in looking glass.
4	"	Lying down, with rest.	Head target.	Standing sight.	3 hits in figure.
5	"	Standing, without rest.	Figure target, in motion.	Flap sight.	2 " "
6	"	Lying down, with rest.	Disappearing breast target.	Standing sight.	2 " "
7	200 m. (220 yds.)	Lying down, without rest.	Infantry target.	Flap sight.	5 hits, of which 3 in central third, of which 2 rectangles.
8	"	Lying down, without rest.	Trunk target.	Standing sight.	3 hits in figure.
9	250 m. (275 yds.)	Kneeling.	Knee target.	"	2 " "
10	"	Lying down, without rest.	Figure target.	Flap sight.	2 " "
11	600 m. (660 yds.)	Kneeling.	2 section targets, together on their sides.	650 metres.	3 hits.
12	300 m. (330 yds.)	Kneeling, 5 shots at word of command.	Section target.	Flap sight.	4 "

Preparatory practice.

To the 3rd class belong all who have not yet gone through a course, or who have not been promoted to a higher class. Those men who fulfil the conditions of practices 5 to 12 of the 3rd class, with 70 cartridges or less, are promoted to the 2nd class. Those of the 2nd class who fulfil the conditions of practices 4 to 10, with 55 or fewer cartridges, are promoted into the 1st class. No man can be put down from a higher class to a lower one.

Those men who go through a course of instruction at the School of Musketry Instruction are at once promoted to the next highest class.

No man can be promoted more than one class in a year, so that the 1st class cannot be reached till the third year's service.

Field firing is divided into two parts—

1. Individual practice.
2. Squad practice.

It is to be carried out after the class shooting, which gives the necessary dexterity with the rifle, and is intended to instruct the soldier as much as possible under the conditions of war.

The *individual practice* has for its object to teach the soldier to utilise ground for cover, to rest his rifle on any support which may offer, to judge distances, and to take advantage of the time during which an object may be visible. As a rule, those under instruction will shoot one after another.

The whole of the Captains and Subalterns, non-commissioned officers, and men of all three classes take part in this portion of the course, for which ten rounds of ball cartridge are allowed per man.

Squad practice is intended not only to teach the men how to act together, but also to instruct and practise the Officers in fire tactics and fire discipline. The regimental or battalion commanders are recommended to take this portion of the work under their own personal guidance, and to have the various units brought up as much as possible to war strength. The practice should be based on some tactical idea, so as to fully educate Officers and men in the various incidents of a modern fire fight.

Twenty rounds of ball cartridge are allowed per man for squad practice in field firing.

It will have been noticed that nothing is laid down concerning the instruction of the men in judging distance. Captains of companies are permitted to give a special course of instruction in this portion of work to their men if they think fit,¹ but it is considered, as a rule, that it can be taught during the course of field firing.

Instruction shooting has for its object to show practically to the men what their rifles are capable of. Thus by firing against a target a number of shots from different ranges, the dispersion of the hits is shown, and comparing these with the size of a man, &c., the probability of hitting can be clearly demonstrated. Similarly by shooting at a target with the sword fixed, the effect of the latter on the accuracy of the fire is shown. Again, ten to twenty men firing at a target at different ranges with the same sight, *e.g.*, at 640, 620, 600, 580, 560,

¹ "Rapport sur l'Armée Allemande." Par Baron Kaulbar. French translation, p. 122 *et seq.*

540 metres, with the sight set for 600 metres, will show what depth of ground is covered by the fire from the given distance, in this case 600 metres, and the result of not judging the range properly. If two or three different elevations of sight are employed, the increased effect thereby obtained will be clearly shown. Thus, for example, using the sights for 400 and 500 metres, it can be shown that the whole of the ground in front of the men up to 550 metres (610 yards) is swept by their fire.

By firing against a number of targets placed one behind another, the effect of the dispersion of the bullets due to differences of range may be graphically exhibited.

To increase the interest of the men in musketry instruction, every battalion receives twenty-two prizes annually; two for the non-commissioned officers of the battalion, viz., one of 9 m. (9s.) for the best shot in the special class, and one of 450 m. (4s. 6d.) for the best in the 1st class.

Five prizes are given for the men of each company, viz., one of 6 m. (6s.), two of 450 m. (4s. 6d.), and two of 150 m. (1s. 6d.). Of these the prize of 6 m. is given for the 1st class shots, and one of each of the other for the 2nd and 3rd class shots.

In case there are no men in one of the classes, the prizes go to the next lowest class.

The distribution of the prizes is determined by the result of the annual course. No soldier can obtain a prize who has not gone through the complete course. At the wish of the winners, the prizes of 9, 6, and 450 m., can be exchanged for silver medals.

In addition to the prizes, twelve badges are given to the twelve best shots of each company among the men.

In order that a comparison may be afforded to the higher authorities of the relative proficiency of the different regiments and battalions in the use of the rifle, a competition shooting (*Prüfungsschiessen*) takes place annually. It consists in the carrying out of certain exercises of a tactical character, which are set each year by the Ministry of War, and are not allowed to be made public before they are carried out. The results are tabulated and forwarded to the proper authorities.¹

For the competition shooting, 3,000 rounds of ball cartridge are allowed for a battalion up to 600 strong, and 4,000 for one over that strength. In addition to this allowance, the company commanders forward annually, on the conclusion of the courses, to the battalion commander, a statement of the amount of ammunition which will be required for the next year. They also send in reports showing the number of men which have been through the course, and the number which have not, with the reasons, the number of men in each class, and names of the recipients of prizes and badges. The battalion commander combines these for his battalion and forwards them to the regiment commander, who again combines them and forwards them on to the higher authorities through the proper channel. Inter-comparison of these reports between companies, battalions, or regiments is not permitted.

¹ Baron Kaulbar's Report gives an example, pp. 169-70.

A very useful means of instruction in aiming is made use of in both Austria, France, and Prussia, and one which will appear novel to most of our readers, viz., the employment of the so-called *chamber rifles*.

These are rifles in every outward respect similar to those with which the men are armed, but they are of very much smaller calibre and fire a shot not much bigger than a pea. They are used, as an addition to aiming drill, to perfect the men in aiming, and possess the advantage of being safe to use in the barrack square or barrack rooms, while their use imparts a *vraisemblance* to the practice and interests the men in a degree which it would otherwise be impossible to attain. Indeed, it is found in Prussia that the men frequently have recourse to them as a source of amusement in barracks.

The Austrian chamber rifle has a calibre of $\cdot 213$ inch, and fires a shot weighing 24.7 grains. The targets are usually placed at about 15 paces from the man, and are constructed so as to have at that distance the same effect that the real targets have at the various ranges. The French rifle has a calibre of $\cdot 22$ inch, and fires a bullet weighing 15.4 grains. No information is given as to the Prussian chamber rifle.

Among the points most worthy of notice in the three different systems of instruction, one of the most prominent is the longitudinal division of the targets in Austria and Prussia. By this arrangement the soldier has always before him a representation of the space within which his bullet would have to hit to strike an adversary standing. It is not so much whether he hits high or low, the chief thing is to hit him somewhere, and by thus dividing the target this fact is constantly brought before and impressed on his mind.

With regard to the Prussian method of aiming, there can be no doubt of its practical utility in the field. But in target practice, as ricochets do not count towards the soldier's score, it must produce great irregularity of result. A bullet is just as likely to hit below the point aimed at as above it. If it flies low, a ricochet is the result and no score for the man, whereas, if the ball flies high, it hits the target and counts, although really there is no greater merit in the one shot than in the other. If the bottom of the target is to be aimed at, it would seem better to adopt the French system of scoring in so far as counting ricochets is concerned. The rest of this latter system, however, in which no account is taken of the position of the hit, except in the case of the annual competitions, seems a doubtful improvement on the usual manner of scoring. It is true that by means of the disc the exact position of each shot is made known to the man; but, on the other hand, this is of little avail if there be no more merit in hitting the centre than the outside of the target. Such a system must lead to carelessness and is deficient of the element of rivalry which plays so important a part in all target practice.

The Austrian and French systems of classifying the men seem to be better than the Prussian. In the two former, a man can attain to the 1st class in the first course of instruction he goes through. In Prussia, no soldier can enter the 1st class till his third year of service. The result of this is, that he has not the chance of improving himself,

whatever his natural ability for shooting may be, and, consequently, it must tend somewhat to keep down the average shooting of the army.

The absence of all systematic instruction in judging distances in the Prussian Army cannot but be regarded as a grave fault. No one denies the merit of the company chief, the company's father as he is so often called in Germany; but it would seem better not to leave so important a part of the art of shooting entirely at his mercy, to teach it or not as he thinks fit. The casual teaching which is given to the soldier during the course of field firing in estimating distances, can by no means take the place of a regular and systematic course of instruction, such as obtains in Austria or France.

That peculiarity in the manner of teaching aiming drill, by the triangle of error used in France, is doubtless of use in showing the men how easy it is not to aim properly; but it would seem probable that the time devoted to it might better be employed in exercises of a more practical character.

A great deal is thought in Germany of the instruction shooting. It is always difficult to judge of the value of any portion of a foreign system; but we fancy that most English Officers would be of the opinion that the cartridges expended on it might be more usefully employed. Men of intelligence can be taught all that it teaches equally well by means of diagrams, and it is only with such that any useful result can be expected in a branch of instruction that is of so very theoretical a character.

Too much praise cannot be bestowed on both the Austrian and Prussian methods of teaching field firing. Accuracy on the target is a very good thing, but it is of little use if the men do not shoot well in war. Both armies lay much stress on familiarizing the soldier with the incidents of the modern infantry fight; and there cannot be any doubt that the fighting value of troops is enormously increased by exercises of this nature.

The use of figure targets, moving¹ and disappearing targets all help to this end, quickness of aim is learnt, and the figure target must greatly help in training the soldier to fire accurately at his ordinary target in the field.

In this practical instruction, the French system is considerably behind those of the other two nations. In their annual regimental schools of instruction, however, they would appear to have a valuable means of keeping up the knowledge of the Officers and non-commissioned officers. It is on these that the direction of the fire fight now falls, and it is of the utmost importance that both should be thoroughly acquainted with all the details necessary for its proper carrying out. It has been seen how much stress is laid upon this in Germany, one of the great objects in field firing being to thoroughly instruct and keep up the knowledge of Officers and non-commissioned officers in fire discipline and fire leading (*feuer disziplin, feuer leitung*).

With regard to the employment of the rifle in the field, the Austrian regulations lay down the following rules:—

Two kinds of fire are recognized, viz., volleys and independent firing.

¹ These were used years ago by the late Sir G. Cathcart.

The soldier skirmishing is not to fire at an enemy, if covered up to the head over 170 yards, or if only half his body be visible beyond 250 yards. Every soldier should be able to hit an enemy standing in the open up to 170 yards, good shots will do so up to 330 yards. Isolated mounted men may be fired at up to 330 yards, if these be Officers the good shots may be permitted to shoot at them up to 500 yards.

Bodies of troops, or small columns up to the breadth of a *zug* (about 13 yards) may be fired at up to 420 yards, or 500 yards if of the depth of a company column. Larger columns may be fired at with good results by practised shots up to 750 yards.

No firing is to be permitted without orders, and is to cease immediately the command is given.

With regard to the fire of closed bodies, volleys may be fired against fully exposed bodies such as battalions, squadrons, or batteries, up to 330 yards, or against smaller objects, such as companies or *züge* up to 250 yards. If, however, the last be half hidden, then only up to 170 yards. The leaders are to be particularly careful that the volleys are fired together; for if some men are allowed to fire before or after the others, independent firing will often ensue.

Independent firing may be used at longer ranges, thus against a battalion in the open up to 500 yards, or against half-concealed companies up to 330 yards. The objection to this nature of fire is that it is difficult to put an end to, and troops get easily out of hand in using it, and to prevent this it is a common practice to define before opening fire, the number of cartridges to be employed by each man.

Concerning the use of long-range fire the following rules are given:—

The decisive stage of an infantry fight lies within a distance of 500 yards from the enemy, within which range an effective fire can be obtained. Nevertheless circumstances will often permit considerable results to be obtained up to ranges of 1,200 yards.

Fire at long range is nevertheless to be regarded as exceptional, and to be employed only against extensive objects. It is to be delivered usually in volleys, under the direct orders of the leaders of several united swarms or closed *züge*.¹

It is impossible to lay down any precise rules for its application; but it is of especial worth when the enemy can be surprised by it, when he can be compelled by it to extend earlier than he would otherwise have done, or when his advance can be hindered by it. Further, it is very useful against a retreating enemy.

Care must however be taken that its use does not involve the want of ammunition at a decisive moment, and especial care must therefore be given to replacing the ammunition when it is employed.

To insure a reasonable effect for a given expenditure of cartridges it should not as a rule be undertaken with bodies of less size than a *zug*, and then only against deep columns and masses, such as company columns, closed supports, and reserves, or thick shooting lines in the open up to 1,000 yards, or against battalion or squadron columns under like conditions up to 1,200 yards. If any of these objects are

¹ An Austrian company is divided into 4 *züge* or sections. A swarm consists of 4 to 7 files under a non-commissioned officer. Each *zug* is led by an Officer.

partially hidden they should have a greater depth than indicated above to justify being fired at.

Batteries of artillery and large staffs may be fired upon up to 1,200 yards under any circumstances.

To save ammunition, the distance should be ascertained by means of preliminary volleys from at least a swarm (8 to 14 men), the falling of the bullets from which will enable the range to be judged.

The leader will order what sight is to be employed, and should as a rule take one rather under than over the range. If the first preliminary volley strikes short, and by the second no visible hit is made, it shows that first sight used was too short, and the second too long. One between the two should then be used. When the right range has been found the leader of the *zug* or company will order three rounds to be fired in volleys, or independently, observing the effect of the fire. If it be desirable, the firing may then be continued. When, owing to the enemy being in standing crops or high grass it would therefore be impossible to observe the points of fall of the bullets in preliminary volleys, it is permissible to employ the back sights set for two or even three different ranges. This is, however, to be very exceptional, as by so doing if the object fired at is not of great depth, a portion of the fire is necessarily thrown away.

The French regulations with regard to the employment of the rifle in the field are very general in character.

Fire is of three kinds, independent, rapid or slow, and volleys. The fire of individuals is only of value when the range is known with sufficient accuracy. By concentrating fire, on the other hand, the dangerous zone is increased by the variation in range of the different projectiles, so that it is possible, under certain circumstances, to obtain a useful effect up to the extreme limits of the sight, *i.e.*, 1,968 yards, or even to the extreme range of the rifle, about 3,800 yards.

In preparing an attack the scouts who lead the way, and who are chosen from among the best shots, commence to reply to the enemy's fire at 800 metres (875 yards). At 600 metres (656 yards) from the defender's position the scouts rejoin the shooting line, and fire is opened along the whole front.

Rapid independent firing is to be used only at close ranges, and with the back sight set for 200 metres. The men then fire as rapidly as possible.

Slow independent firing may be carried on either by the whole of a shooting line firing slowly, or by certain individual soldiers firing by command.

Volleys are particularly adapted for long-range fire, as they enable the troops to be kept better in hand.

When the men are under instruction they are to be taught the following rules for their own individual guidance.

As a rule it is not advantageous to fire at greater ranges than up to 270 yards against single or sheltered skirmishers, or beyond 440 yards, at a shooting line in the open or single horsemen. Closed supports may be fired at up to 550 or 650 yards, or reserves up to 870 yards. Larger masses of troops, or a battery of artillery, may be fired at up to 1,100 yards.

These rules are more especially applicable to the common soldiers.

Officers may, if they think fit, depart from them; but they must then indicate the object to be fired at, and the sight to be employed.

A great part of the ineffectiveness of fire in war is due to errors in judging distances. To obviate this it is proposed to furnish the Officers of the French infantry with range finders of a portable form.

Experiments have lately been conducted with numerous varieties, both optical and acoustic. The latter have been rejected as unsuited to the battle-field, and four of the optical ones submitted have been recommended for trial at the various schools of musketry. All of these gave the range of an object at 1,000 metres distance within from 35 to 38 metres, in a time varying from 2 to $2\frac{1}{2}$ minutes. They are inexpensive, costing only from 8 to 40 francs, portable in form, and of solid construction, not liable to get out of order.

The Prussian drill-book lays down that it is not expedient to fire at single individuals over 275 yards, or on larger objects, such as columns or artillery, over 550 yards.

The "Musketry Instructions," however, say that if the limit of range be that at which every shot may be expected to hit, then it is not expedient to fire at over 220 yards against isolated individuals lying down or more than half under cover, or at over 275 yards at objects the breadth of a man, and of the height of one standing in the open or half under cover. Broad objects, half the height of a man, may be fired at up to 385 yards, or if the whole height of a man, up to 450 to 500 yards. If the distance be exactly known these ranges may be increased to 500 and 720 yards respectively. Beyond these limits, certainty of effect is only to be obtained by the concentrated fire of a number of rifles on the same object, and the useful percentage of hits will depend on the height, breadth, and depth of the object.

For practical purposes the Table A gives sufficient data for ascertaining the desirability or otherwise of opening fire. From this table it will be seen that up to 770 yards the company column standing suffers somewhat more than the company in line; but that from that distance up to 1,760 yards its loss is more than double. A company column lying down will suffer at all ranges twice or three times as much as a company lying down in line.

The losses of a shooting line as compared with that of a company in line will vary with its thickness as compared with that of the latter.

By the employment of two or three different heights of back sight the depth of the dangerous zone is doubled and trebled respectively. In place of there being one portion of the zone at which the bullets fall most thickly there will be two such, and consequently instead of one short central strip of greatest effect, there will be a much longer one over which the falling projectiles will be pretty equally spread.

Table B, based on a long series of experiments, carried out at the School of Musketry at Spandan, will clearly show this difference, but the averages laid down therein will only be reached when a large number of rifles are concentrated against the same object.

To get a good effect against objects distant more than 770 yards requires a large expenditure of ammunition, and if it is to be quickly attained, a proportionately large number of men must be employed.

Under certain circumstances, however, a good effect against large objects such as batteries and closed bodies of troops may be obtained up to 1,320 yards.

Three kinds of fire are recognized, viz., slow and rapid independent firing and volleys. Volleys have the advantage of keeping the men better in hand, the effect of the projectiles is more easily seen, and the sights therefore more easily regulated.

On the other hand, the men shoot better in slow independent firing; but with thick shooting lines the powder-smoke has a tendency to hang in front, and then volleys are preferable, giving time for it to clear away.

In using slow independent fire, the number of cartridges to be used, usually not more than three, should be named beforehand, so as to prevent it degenerating into an unregulated expenditure of ammunition. Pauses will by this means ensue in the fire, which will allow the smoke to clear off. With rapid independent firing the men get quickly out of hand, and from the smoke clinging to the front of the troops, it must often be unaimed. It leads also to an excessive expenditure of ammunition, and should therefore be as little used as possible.

The choice of the object aimed at will depend on tactical considerations; but frequent change of aim should be avoided, and the objects chosen should be such as afford a fair prospect of good results.

The proper elevation can be obtained from the artillery, if any be near at hand, or by preparatory volleys, or by means of a good detailed map. It is not necessary to know the exact length of the range to a yard; it is sufficient to know that it lies within a certain space, as between 500 and 600 yards or between 700 and 900 yards. Beyond 440 yards the use of one elevation of back sight only is not desirable, unless the object is motionless, its range known, and the ground on which it stands favourable to the effect of the projectiles. In all other cases, especially when the object is in motion, two different heights of back sight, differing from one another by 100 metres (110 yards) should be used. Up to 770 yards two different heights will suffice, beyond that, three will be required.

To use two different heights of sight, one should be employed by each *zug*, if three are to be employed, each rank should take one.

It is not well to employ two or three different heights of sight, unless the body of troops employing them is of at least the strength of a *zug* or company (125 to 250 men).

In determining the different heights of sight to be made use of, care must be taken that such are selected as will cover the zone to be swept with projectiles. Thus if the object lie between 600 and 800 yards from the troops, sights should be used for 650 and 750 yards, if between 700 and 1,000 yards, those for 750, 850, and 950 yards.

The great military nations of Europe, as will be seen from the foregoing pages, have lately made considerable alterations not only in their methods of musketry instruction, but also in the manner in which they propose to employ the rifle in war.

To the student of the literature which has resulted from the war of 1870-71 it may at first seem strange that this new departure, the use

of long-range fire, should originate with the nation which attributed its victories in great part to reliance on well-disciplined fire-action at close ranges; but an investigation of the evidence from which this verdict was obtained will, we think, lead our readers to admit that its recent reversal was fully justified.

The history of every action which took place during that war shows that the commencement of an infantry attack was conducted broadly as follows: the advance was first of all prepared by a concentrated fire of artillery which served in great measure to shake the hostile line. Where this could not be done, as at Spichern, owing to want of guns and a good artillery position, or was not done, as in the case of the Guards' attack at Gravelotte, we find that either enormous loss was sustained, as in the first case, or, as in the second, the attack was brought to a standstill. When, however, it was practicable to push on, the formation most generally employed was that of company columns, the flank companies, usually in advance with one *zug* extended as skirmishers, and the other two *züge* in close order as supports, while the two centre companies, massed on the centre, followed as reserves, separating from one another as they came under the influence of the enemy's fire.

This formation, long existent as an alternative disposition of the Prussian drill-book, was only recognized as the proper one after the campaign of 1866. There had not been wanting critics who foretold before that war, that this must be the future method of attack, and Prince Frederick Charles, in his remarkable pamphlet, distinctly lays it down as being the best suited to modern requirements. The military mind, however, is no less conservative in Prussia than elsewhere, and there was a tendency throughout the whole of the Austro-Prussian War to adhere to older and more honoured forms. For instance, the Vth Corps under the well-known General von Steinnitz manoeuvred throughout the campaign in half-battalion columns. Nevertheless, whatever might be the initial formation it was soon found that under fire one form only was admissible, and skirmishers, supports, and even reserves, became merged into one shooting line at open intervals. There were two reasons for this. First of all, men do not like being fired at without firing back again; do not like being killed by the enemy without a chance of killing him, which led to the supports and reserves, thrown out of their closed formations by the fire of the enemy, rushing forward to their comrades in the skirmishing line to join them in crushing him with their fire. Secondly, there was the desire to get to a range of 300 to 400 yards, from which alone the men knew they could fire with decisive effect. This course of action was greatly facilitated by the continuous fire kept up by the skirmishers, which rivetted in great measure the attention of the defenders, and thus aided the advance of the troops in rear. It must not be forgotten, however, that the Austrians were armed with a slow-firing large-bore muzzle-loading rifle, and that they proposed to overcome the superiority of fire possessed by their adversaries by the liberal use of the bayonet, thus playing into the hands of their adversaries.¹ They did attempt to carry out this purpose; but the attacks

¹ See Benedek's proclamation to his army.

were often ill-directed, carried out as a rule straight to the front, and where this was the case, or where open ground had to be crossed, they never succeeded.¹

The consequence of all this was that, after the war, it was admitted that company columns covered by skirmishers was the proper attack formation, and, as we have seen, it was the one universally adopted in the Franco-German War. At the same time, it was laid down that fire could only be considered effective at close ranges, and that every effort should be made to get the troops within a proper distance before commencing the fire fight; and this form of attack was taught and practised very generally throughout the Prussian Army, as pointed out in the reply to the "Tactical Retrospect," which reply, as is well known, was inspired by von Moltke himself.

In the war against the French, however, the Prussians found an enemy armed with a weapon ten times as powerful as that which they had encountered in their last campaign, and one which was vastly superior to their own. He made extended use, too, of an entirely new feature in war, *rapid, wide-ranging infantry fire*. Not only supports, but reserves also, were struck by it, and the dissolving effect on the attacking troops was therefore much greater, and was felt much earlier in the action. No mere extension of the shooting *züge* was sufficient; it was absolutely necessary to engage a number of rifles at least equal to the number employed by the defenders. The feeble skirmishing line at first made use of could not get on without reinforcements, which were rendered doubly necessary by the heavy losses caused by the enemy's fire. And so it followed that, first of all, the supports became absorbed in the skirmishing line, and then, if the losses were severe, or if the advance were checked, the reserve, too, joined the front line, all alike eager to get near enough to the enemy to return with effect his fire, which they could not support without reply. What, therefore, had hitherto been regarded merely as a screen to cover the advance of the closed main body, became the real fighting line, made up of various companies and battalions, in some cases even of different brigades, which carried positions always in extended order, and was composed of individual groups kept together and impelled forward only by the example of their Officers and the mutual desire to act in common support against the enemy. Such a line might, and very often did, sway backwards and forwards, as it felt the pressure of the enemy's fire or was carried on by the impulse afforded to it by fresh troops sent into it from the rear; but it alone won the victory, nor is there any example of its merely preparing the way for the advance of troops in closed formations.

The descriptions of the various battles of the war, of which Woerth,

¹ The attack of the Archduke Joseph's brigade on the wood of Maslowed at the battle of Koniggratz was a partial success, but purchased at a heavy sacrifice. See "Campaign of 1866," translated from the Prussian official account, by Hosier and von Wright, pp. 197 and 198. On the other hand, three Austrian battalions advancing against Diletz (Battle of Gitschin, 29th June) were easily driven back by the fire of four Prussian companies. *Ibid.*, p. 136. Again at Nachod, 27th June, where 5½ battalions held at bay for three hours 21 Austrian battalions, and repulsed their repeated attacks, pp. 84—89.

Spicheren, and Vionville may be taken as good examples, given in the official account of the war compiled by the Prussian Staff, give an accurate and vivid description of this method of fighting, and may be consulted with advantage, as typifying the conduct of the attacking infantry under the influence of modern rifle fire.¹

The tactical outcome of the war, then, so far as infantry was concerned, was—

1. The actual fighting must be done by troops in dispersed order, supported, if possible, by closed bodies;

2. The decisive fire-zone extends only to 400 or 500 yards from the enemy, and every effort should be made to prevent the attacking troops opening fire till they reach this distance.²

The long-range fire made use of by the French was treated as unaimed fire, which would occasion loss to, but could never stop, a well-trained infantry.³

Now, with reference to these deductions, it must not be forgotten that the Germans were armed with a far inferior weapon to the French, and also that the latter, although making use of long-range fire, had never trained their troops in its proper use. Therefore, it is evident that, whereas we may admit the tactical formations deduced by German experience from the late war, it by no means follows that their conclusions as to the proper use of the rifle were right, or that, because the French made use of unaimed long-range fire, it is impossible to instruct troops in the proper employment of aimed fire at ranges considerably beyond those which the successful employment of fire at short ranges by the Germans had led the latter to suppose was possible or desirable.

No one can deny the desirability of arriving at an effective range before commencing the real fire fight; but the question arises, What is an effective range? With the old smooth-bore, Frederick the Great loved to impress on his soldiers that they should reserve their fire till the whites of their adversaries' eyes were visible. We ourselves gained most of our Peninsular victories by the judicious use of infantry fire at effective, *then* close ranges. But events have marched since then, and with the Martini-Henry a better target can be made at 1,000 yards than could be made with Brown Bess at 100 yards; and a review of the various wars which have taken place since the middle of the last century will prove that the tendency has always been, as firearms have improved, to increase the range at which fire may be opened. The consequence of this has been a gradual tendency to replace the tactics of shock by those of fire, and, as this involves more individual action on the part of the soldier, and has moreover the apparent, but by no means real, tendency to do away in a great measure with the authority of the Officer, there has always been the opposition cry, "Your

¹ For a more detailed account of what was seen and felt by a company Officer, see "The Frontal Attack of Infantry," pp. 10—13.

² Von Scherff in "The New Tactics of Infantry," written after the war, puts this distance at between 200 and 400 paces.

³ See Major von Tellenbach's pamphlet, the French translation of which is entitled, "L'art d'opérer sous le feu ennemi avec le moins de pertes possible."

"troops will be a mere mob; discipline will disappear from the field, and your soldiers will no longer be kept in hand and available for the ever-varying requirements of the fight." To which it may be replied that the problem to be solved is to see how this loosening, which cannot be avoided, may be taken advantage of and adapted to attain its true end.

It has, indeed, been a hard struggle to gain the admission that the bullet is superior to the bayonet, but it must now be finally conceded that the former, not the latter, is the true weapon of infantry, and that it is in the proper use of the rifle that superiority must henceforth be sought. It is not meant by this that the bayonet may henceforth be relegated to the same limbo with the arquebuss and pike. Far from it; occasions will still occur, as has been lately seen in the Russo-Turkish War, where a final appeal must be made to the bayonet, and if only for the sake of the moral support afforded by it to the troops, we can never expect to abolish it from the Army. What is meant is, that henceforth it is to fire, and not to the final hand-to-hand conflict, that the decision of the fight must be looked.

This being the case, we may therefore ask, Has not the day arrived when we must admit that infantry may open fire at ranges not hitherto dreamt of? The Prussian (German) answer is "yes," and the Austrians and Russians back them in their opinion.

Let us then by reference, first of all, to actual example, and, secondly, by a consideration of the theoretical aspects of the question, see what may be expected of long-range infantry fire.

When the French entered on the campaign, they possessed, in the Chassepôt, a weapon which they knew was superior to the needle rifle, not only in accuracy and rapidity of fire, but also and more especially in range.

There was, then, a natural tendency to fire as early as possible at the enemy, and overwhelm him with a storm of bullets before he could approach to the attack, that is, at a time when, by the inferiority of his weapon, he would be unable to reply. The action at Mentana had encouraged this tendency, and, as the results of that action were well known throughout the French Army, the inclination to rely on long-range fire, which had been so successful there, was increased.

Moreover in the tactical instruction of the infantry as laid down in the "Observations sur l'Instruction sommaire pour les Combats," published by the French War Office in 1867, and drawn up by Marshal Niel, great stress is laid on the value of the defensive, and on the necessity of allowing the enemy to attack in order to crush him by fire. The French nature being impulsive, and the whole tradition of the Army pointing to offence rather than defence, there would naturally be great difficulty in keeping the men in hand and restraining them from advancing. The spirit which formerly had found an outlet in the attack, and which must have a vent somehow, found it in the maintenance of an incessant fire. Deficiency in fire discipline, and the position of the troops behind cover, led to a large amount of this fire being unaimed, and the consequence was that the ground in front of

the position up to a distance of 1,200 or 1,800 paces¹ was more or less swept with projectiles. To such an extent was this long-range unaimed fire carried out, that in his pamphlet entitled "*Mode d'Attaque de l'Infanterie Prussienne*," the Duke of Wurtemberg states that the French soldiers often fired from the hip, their rifles inclined at an angle of 45°, their sole object apparently being to fire as rapidly as possible without the trouble of aiming. One result of this was that when the Germans approached the French, the latter still keeping to this method of firing, a large number of bullets would pass harmlessly away, and it was often remarked by German Officers that the nearer they approached the less did they suffer.²

Nevertheless, unaimed as it no doubt in a great measure was, this long-range infantry fire caused on many occasions severe loss to the Germans, of which perhaps the best known case is that of the Prussian Guards at St. Privat.

It will be remembered that the object of the Germans in the battle of Gravelotte was to turn the French right wing. For this purpose the Saxon Corps was sent by a long *détour* to outflank the French, while the Guard Corps had for its object a more direct attack on the enemy's extreme right. About 5 p.m., Prince Augustus of Wurtemberg, the commander of the Guard Corps, considering that the turning movement of the Saxons would soon begin to take effect, and knowing the difficulty in which the IXth Corps found itself, determined to attack the village of St. Privat. The 4th Brigade of the Guard advanced against it from St. Ail, on the south of the high road, while the 1st Brigade moved from Ste. Marie aux Chènes, on the north of the road. The brigades did not move simultaneously, as the 1st had to march from its position southwest of Ste. Marie; but it followed the 4th about twenty minutes later, commencing its advance about 5.45 p.m. Now, Ste. Marie aux Chènes is distant about 2,500 paces from St. Privat, and St. Ail is about 3,500 paces from it. Shortly after the advance commenced, that is probably the moment the battalions were seen from the French position to be advancing against it, they were met by a storm of artillery and *infantry* fire, so severe in character that none of these troops could approach nearer than about 600 to 800 paces from the village, and at 6.15 p.m. they halted, crouching on the slope or wherever a slight shelter could be found from the murderous fire of the enemy. How severe this fire was may be judged from the fact that in this advance, which did not occupy more than from a half to three-quarters of an hour, the 2nd and 4th Grenadiers and the 1st and 3rd Foot Guards (4th and 3rd Brigades) each lost one-third of their strength. The testimony of all concerned, points to this loss being chiefly caused by rifle fire³ delivered at ranges varying from 800 to 2,000 paces.

¹ See "Studies in the New Tactics of Infantry," by von Scherff; and also von Schell's latest work, "*Studie über die Taktik der Feldartillerie*."

² "Frontal Attack of Infantry," p. 31, and "*Mode d'Attaque de l'Infanterie Prussienne*," p. 10.

³ See the "Official Account of the War," vol. ii, p. 128 *et seq.*; Hoffbauer's "German Artillery," p. 264 *et seq.*; "*Mode d'Attaque de l'Infanterie Prussienne*," p. 15. The percentage of the German losses due to infantry fire was 94 per cent., the artillery only causing 5 per cent., and Hoffbauer says, moreover, that the French

It is true that the formation used by the Guards was a very deep one at first setting out, but the fire of the enemy soon dissolved it into a deep skirmishing line, in which form a large proportion at least of the loss must have been sustained.

Here, then, we have an actual example which proves beyond doubt that long-range fire is capable of inflicting great loss, and the result of this portion of the battle of Gravelotte may be fairly used as a powerful argument in its favour. If it be objected that this fire was unaimed, it may then be replied that from aimed fire greater results may be hoped. But if, on the other hand, we assume that it was to a certain extent aimed, then also may we expect that when an infantry has been trained in its execution, which the French certainly were not, an increase in effect will be the consequence.

The value of long-range infantry fire has received a further proof in the war between the Russians and the Turks. Here, as in the Franco-German War, the one side was much better armed than the other. For the Martini-Peabody rifle and the Krupp breech-loading gun were as superior to the Krinka rifle and the bronze muzzle-loader, as the two latter were to the arms of the past half century.

The Russian military review, "Woyainie Sbornik," in its number for May,¹ has published the views of General Seddeler on this subject. This Officer, who commanded the 1st Brigade of the 2nd Guard Infantry Division through the war up to the action of Gorny Dubniak, 24th October, 1877, when he was wounded and compelled to leave the Army, says (and in this all eye-witnesses of the war concur) that the fire tactics of the Turks consisted simply in firing at all distances up to the extreme range of their rifles as quickly as was possible. The consequence of this was, that at even 2,500 yards the effect of the infantry fire began to be felt.² At 1,700 yards the losses therefrom became considerable, and from that distance onwards the fire grew hotter and hotter, till at last it became a perfect rain of lead, such as none but those who have gone through can possibly picture to themselves. Contrary to what had been often experienced during the Franco-German War, the fire was not much less deadly at the nearer ranges than it had been some distance further off, and the actual attack was only carried out with frightful loss.

Now the Turkish infantry is essentially an uninstructed one. A large proportion were perfectly ignorant of the proper use of sights, and if, as there can be no doubt, their fire, in great part unaimed, in the true sense of the term, could yet produce such fearful losses, it stands to reason, that had the Russians been opposed by a better trained soldiery, their losses would have been far greater.

So far the value of rapid long-range infantry fire as shown by example. Let us now investigate the question theoretically, and see to what extent the proposed change is justified.

artillery had been obliged to withdraw to the rear (p. 236), its fire could not therefore have been very formidable.

¹ A translation of these into German has appeared in Nos. 64, 65, 70, 72, 73, and 74 of the "Militair-Wochenblatt" of this year.

² General Todleben, in a letter to General Brialmont, dated 18th January, 1878, says:—"The infantry fire fell like a rain of bullets up to more than two kilometres (2,200 yards) distance."

As long as infantry were armed with a muzzle-loading rifle, there was good reason to place chief reliance on the effect of close-range fire. The weapon did not permit rapidity, and was inaccurate at ranges beyond those at which the object aimed at was clearly visible, say 400 to 500 yards. The assailant, moreover, made use of closed formations, chiefly columns, which advanced without firing, or which, at the best, could give but a very feeble fire. If, then, the fire was reserved till these neared the defendants, the effect would be so very great as in most cases to be decisive. Now, however, the attack takes place exclusively in open order and a powerful fire is brought to bear on the defenders. No closed bodies of troops are offered as targets to the rifles of their adversaries within anything like what may be called close range, and by far the best objects to fire at, both for moral and physical reasons, are formed now-a-days by the front shooting line of the enemy and its supports. To reserve all fire against these until they reach ranges at which it would have been possible to effectually crush them with the old rifles, would be wilfully to throw away the advantage of the new ones, viz., rapidity and accuracy at long range. The experience of two campaigns has shown, that with modern weapons, even unaimed, undisciplined fire is capable of giving great results at long ranges, and if, therefore, we can employ well aimed fire, it follows we shall obtain greater results.

Several objections have been made to this deduction.

1. Long-range fire is not so effective as supposed, the proportion of hits to misses being very great, and it follows, therefore, that it is better to reserve fire for ranges where the proportion is more favourable.

2. It would be impossible to keep up the necessary supply of ammunition, and, consequently, there would very likely be a dearth of cartridges at the decisive moment of the struggle.

3. The employment of long-range fire would be the death of the spirit of the offensive.

4. The large columns and other widely spread-out objects, against which this species of fire is thought to be so very effective, are less and less seen on the field of battle.

5. Firing at the same object with the sights set for different ranges, as proposed in Germany, is the negation of accuracy of fire.

With regard to the first objection, it must at once be admitted, that we have no statistics based on experience in actual war, as to the "useful effect" obtained by troops who have employed long-range fire in the field.¹ But we have a large mass of information derived from peace experiments, and although they will not, of course, represent what may be expected in war, still, whether experiments are carried on at short or long ranges, it cannot be admitted that the proportion between war and peace results should be greater in the one than in the other case.

Trials made in France and in Austria would seem to show that an

¹ It is improbable, however, that the French 6th Corps at Gravelotte expended more than about 60 rounds per man; at any rate, recent evidence shows that the want of ammunition could not have been so great as was at one time supposed. See "*Méthodes de Guerres Actuelles, &c.*" vol. i, p. 674.

average shot would hit a man once in three times at about 600 yards. On the other hand, it is said that the useful percentage of shots fired in actual war varies from 7 to 12 per cent.¹ Be this as it may, the percentage would be the same for all ranges, and will not, therefore, affect the question.

Since 1872, a number of experiments has been carried on in Prussia, at Spandau, and in Bavaria, at Munich, with a view to ascertaining the actual value, under conditions resembling as much as possible those of war, of long-range fire. The questions which were put for solution were:—

1. Has rapid long-range infantry fire directed against a visible or invisible enemy any value in war?

2. If so, how should it be applied, by volleys or by independent firing?

3. What regulations are necessary to maintain fire discipline if it be introduced?

The replies to the first of these questions being favourable, resulted in the new rules for the use of the rifle in war, embodied in the newly published "Musketry Instructions," which also deal with the third query. With regard to the second, it was found that although rather better results were obtained from independent than from volley firing, still the latter is so much more favourable to leadership and keeping the men in hand, that it should, as a rule, be employed for this kind of fire.

So far as the actual effect is concerned, the outcome of the experiments is shown in tables A and B at the end of this paper, which certainly show a sufficiently useful percentage to justify the use of long-range fire. Since then, the new musketry manual has been introduced, and the exercises therein laid down have been carried out in various regiments.

In the *Allgemeine Militär Zeitung*, of the 8th of April of this year, a German Officer gives the following account of what he saw at a field firing practice at which he was present.

"A thick shooting line was represented by 240 head targets placed chequerwise. To these 120 skirmishers were opposed, who first of all ascertained the range by preparatory volleys, and then fired with two different elevations 1,800 shots. The number of hits was 69, or nearly 4 per cent., the number rendered *hors de combat* being 61 men, some of the figures receiving more than one shot.

"On the same occasion, 90 breast targets were placed at distances apart equal to their breadth, and 600 shots were fired at them from a distance of 600 metres, with two heights of sight. The number of hits was 38, 6½ per cent., putting 26 men out of action.

"Lastly, at a range of 700 metres, 100 whole figures were arranged as in the second case. With two different elevations 300 shots were fired at them. The number of hits was 27, *i.e.*, 9 per cent., which put 22 men out of action."

Now these experiments were conducted under conditions representing, as far as possible, the conditions of actual war. It is not too much to say, that the results are much more favourable than we have hitherto been led to suppose could possibly be the case.

¹ See "Instructions Pratique de la Compagnie d'Infanterie, &c.," p. 154 *et seq.*

In Austria also, where long-range infantry fire has for some time past been growing in favour, numerous experiments have been made, and among the troops themselves two courses have been carried out, one in the winter of 1876, and one in that of 1877. The average percentage of hits obtained in 1877, during the course of field firing, at ranges varying between about 670 yards and 1,140 yards, and 1,140 yards and 670 yards, the men advancing and retiring, was 31·2. The object aimed at, representing a double column of company columns on the centre, was formed by three targets placed one behind the other, with intervals of 24 paces, each target being 6 feet high and 120 feet long. It is true that such objects as columns measuring 40 yards each way will seldom be met with on the battle-field; but if a like percentage be maintained, a company column would have been struck 7 times out of every 100 shots fired in volleys by the attacking troops while advancing and retiring over ground between ranges of nearly 700 and 1,200 yards. It must, moreover, be remembered, that the weather was extremely unfavourable, even for winter, when the shooting took place.

On 26th February of this year, some experiments were conducted at Vienna against artillery. A company of infantry fired at 1,400 metres (1,532 yards), against targets representing 3 guns in action, with their detachments. Ten cartridges were fired by each of the 211 men in the ranks of the company. Nearly 10 per cent., or 189 balls, struck the targets, in other words, the guns were silenced in about $3\frac{1}{2}$ minutes, the whole of the 108 men forming the *personnel* being hit within that time.

As was remarked in a recent lecture given by Lieutenant-Colonel Grossmann of the Artillery, at Vienna, such experiments tend to show that the artillery will be called on to suffer very sensible losses at 1,600 paces instead of 800 paces, which has hitherto been considered the limit of the effect range of infantry fire.

In August last a very excellent example of how field firing should be conducted was given by the 3rd and 26th battalions of riflemen stationed in Upper Austria.

On the 19th August these two battalions started from the respective garrisons at 2 P.M. in full marching order with two days' rations of biscuit. The day was very hot, the thermometer marking 104° Fahrenheit. They reached their bivouac at 9 P.M., after a march of about fourteen miles, placed their outposts, lighted their camp fires and bivouacked on the bare ground. The next morning they stood to arms at 7.30 A.M., and the two battalions, which were on peace strength, were united so as to form one on war strength. The total number of men in the ranks was 743, of whom 84 were 1st class, 328 2nd class, and 331 3rd class shots.

The ground over which the manœuvre took place consisted of a valley between two far-projecting spurs. The enemy occupied the upper end of the valley, the lower end of which was closed by the village of Edtsdorf. From the village to the position occupied by the defenders was a distance of about 2,500 yards. For the first thousand yards the slope was gentle and regular; but thence it became much more undulating and afforded good cover in places to the attacking troops. On the other hand these

undulations often hid the enemy from view, especially from that portion of the ground comprised between 670 and 840 yards from his position. The right flank and centre of the defenders' shooting line was also partially hidden by a row of trees in front of it. The northern spur was clothed on its northern side with a wood which was of considerable tactical value in turning the defenders' flank.

It will thus be seen that the position was one of an average character such as might frequently be met with any day in war. The enemy which occupied it was supposed to be three companies strong. The shooting line was about 200 paces long, divided into five sections. It was formed by targets 1 foot high and of the requisite length. There were three supports represented by targets 61 feet 7 inches long and 37 inches high. The reserves were represented by disappearing targets 54 feet long, the full height of a man, viz., 5 feet 6 inches. These were made visible for 5 to 10 seconds at intervals of 3 to 5 minutes.

The line occupied was fairly straight except that the left flank was thrown forward, forming an offensive crotchet.

The proceedings were conducted in strict accordance with a tactical idea laid down beforehand. At 8 o'clock the battalion commenced its advance towards the ground where the firing was to take place. At 10.10 A.M. the advanced guard made out the position of the enemy. At 10.20 A.M. the fight commenced by the advanced guard, one quarter of the 4th company, firing volleys on the enemy, at about 1,200 to 1,500 paces (1,000 to 1,250 yards). When at about 900 yards from the defenders the shooting line was formed by the whole of the 4th company, the 3rd acting as its support at 1,150 yards, the 1st and 2nd companies being in reserve. One section of the 3rd company and one of the 1st fired volleys over the head of the skirmishers, which the nature of the ground permitted to be done, the range being about 1,150 yards. At about 750 yards the shooting line was formed by the 3rd and 4th companies with one section of the 1st, the remainder of the battalion being in reserve.

At 400 yards the 1st, 3rd, and 4th companies formed the front line, the 2nd being in support. At 170 to 200 yards, the 2nd company joined the right flank of the chain in closed order. The intention being to turn the enemy's left flank, the right prepared to advance covered by the rapid fire of the left; but at this moment the action was stopped, the commandant of the battalion thinking the object of the exercise was gained. In a shooting line extending over 300 paces reinforced by the supports in closed ranks, the fire had twice been stopped, the greatest difficulty was conquered, to continue the fire would only be to riddle the targets.

It may be fairly said that here we have practical experiment bearing all the impress of war.

Up to a distance of 400 yards from the defenders, shooting line and supports alike fired volleys, the former by swarms. From that point independent firing was used, the number of cartridges being always fixed beforehand. Rapid independent firing was employed only for a short time at the last moment.

The number of cartridges fired was 21,193, of which 2,292, 11 per

cent. nearly, struck the targets, 1,686 of them within the figure spaces marked out by a black outline. The supports suffered most, 77½ per cent. striking them; 12½ per cent. struck the shooting line and 10 per cent. the reserves.

These results are not so good as have been obtained on other occasions, but are especially valuable from their practical character, representing more nearly what may be expected in war.

Recent experiments in Russia have shown that, at even at 3,000 yards, 8 per cent. of the bullets from a Berdan rifle falls within a space of 30 paces by 30 paces. The correspondent of the *Standard*, in the issue of the 16th September, states that the Officers who had been ordered to the camp at Chalons, to see some experiments conducted with long-range infantry fire, were much struck with the effects obtained, and that "it has been satisfactorily proved that, if a company "of infantry succeed in creeping up to within 1,200 or to 1,500 yards "of a battery of artillery, horses and men would all be disposed of in "a very few minutes."

The question has also been worked at in the British Army and experiments on the subject have been made at different stations. *The Times* of the 23rd and 25th October gives the following accounts of some that were recently carried out at Dumdum and Meerut.

At Dumdum a half-battery in action was represented by logs of wood on trestles placed at proper intervals, the gunners being represented by targets painted black, 4 feet high by 20 inches broad at the bottom, but narrow at the top to represent a man's head, which was painted white. The limbers and teams were represented by targets, 8 feet square, painted a neutral tint. Twenty men fired 200 rounds at 1,500 yards independently, hitting the gunners eight times, the limbers and teams three times. They then fired volleys by alternate sections of ten, firing altogether 200 rounds with the following result, viz.:—hits on gunners, 28; hits on limbers and teams, 16; total, 44.

At Meerut, 56 men fired 948 rounds in 2 minutes 57 seconds, at a target 18 feet long and 6 feet high, at a range of 1,200 yards, making 153 hits, or 16·35 per cent.

Now, we have seen what has been accomplished in actual war by long-range fire, and we have also seen what has been the result of peace experiments. The two nations—Germany and Russia—who have suffered more from its employment are now its warmest advocates. Austria and France follow suit, and in the face of such a consensus of opinion, backed by actual experience and supported by a long course of experiments, it is not too much to say that the first of the objections to its use, viz., that the result is not worth the expenditure of ammunition, is fully refuted.

Long-range firing must be under the immediate supervision of the leaders, the men can never be allowed to open fire when they like, and to fire as many cartridges as they like. But if an Officer sees that an opportunity offers of employing long-range fire with success, it would surely be wrong to say under no circumstances is it to be permitted.

The question is, what is waste of ammunition? Is every bullet that does not hit a man wasted? If so, the vast proportion fired even at short ranges is thrown away. In reality the employment of ammunition only ceases to be judicious when the number of hits does not bear a proper relation to the number of cartridges expended, *i.e.*, with the results which ought to be obtained, taking into consideration the known ballistic capabilities of the weapon. Admitting this, the foregoing pages show plainly that long-range firing is admissible.

With regard to the second objection, *viz.*, the vast expenditure of ammunition and the consequent difficulty of supply, it may be remarked that precisely the same objection was urged on the introduction of breech-loaders. Nevertheless, three wars have been fought with breech-loading rifles, and where a proper discipline obtained, no difficulty in the supply of ammunition was felt.

If, as is doubtless the case, a somewhat larger supply of ammunition will be required—General Seddeler says each man should have 105 rounds with him—this is a question of administrative detail, one which the Turks successfully solved both on the offensive and defensive, and it is surely not therefore beyond the capability of civilized nations.¹ In England the adoption of the Oliver equipment would entirely settle the question.

It is further urged that the introduction of long-range fire would be the death of the offensive spirit, the true secret of success in war.

This objection is one which, being based chiefly on moral grounds, is very difficult to prove or disprove.

"If," say the opponents of distant fire, "you allow men to open fire from a distance, you won't get them to advance. They'll prefer to lie quietly where they are and fire away at what they think a safe distance from the enemy."

But, on the other hand, it may be replied that this would only be possible with undisciplined troops, not in hand as they should be. Moreover, if the men find their fire is taking effect, there will be very little difficulty in urging them on to complete the defeat of the enemy. As a practical fact, too, it may be added that in all wars it is found that when men advancing begin to feel the fire of the enemy it is impossible to restrain them from replying to it.²

Another point, which is made a great deal of, is that the advocates of long-range fire base much of their argument on the loss which will accrue to large columns, such as a battalion column, whereas such formations will no more be found on the battle-field.

This objection may to a certain point be admitted, but practical experience and experiment alike go to show that smaller objects, such as company columns and thick shooting lines, would suffer considerably from fire at ranges hitherto thought beyond danger.

At any rate, it must be admitted that the new fire will affect consi-

¹ See Colonel Clive's lecture, vol. xxi, p. 831 *et seq.*, of the Journal of this Institution.

² A good example of this is given at page 10 of the "Frontal Attack of Infantry," and it is well known how impossible Frederick the Great found it to get his troops to advance without firing. Marshal Bugeaud says the same of the French columns attacking the English in the Peninsula.

derably the rôle of artillery and cavalry. Neither of these arms can avoid offering a large target to the enemy. Cavalry can do nothing till it closes with its enemy, and it will now suffer from rifle fire from 1,500 yards to the muzzle. At 1,500 yards fifty men in dispersed order would afford but a poor target to a battery; nevertheless, concentrating their fire on gun after gun, they would, as we have already seen, very quickly reduce it to silence.

With regard to the last objection, which, however, is one chiefly affecting the German mode of employing long-range infantry fire, it is impossible, in the present state of the question, to say definitely whether it is, or is not, expedient to fire at the same object with two different heights of sight. The bullet-rain is thereby spread more evenly over a given surface and the zone of greatest effect is considerably deepened. But, on the other hand, within each half of that zone only half the number of bullets fall that would take effect were only one sight employed. Consequently it would seem that, unless the object fired at were moving, or the range were unascertainable with anything like accuracy, or the object itself were very deep, it would not be judicious to employ it.

There is no doubt that the general question under consideration is bound up to a very great extent with that of judging distance; for at long ranges the depth of the dangerous zone becomes very small, and if a proper effect is to be produced, the range must be accurately ascertained. The French, as has been before mentioned, are making experiments with infantry range-finders. We too in England have been doing the same. In the meantime recourse must be had to preliminary volleys, estimation by the eye, or to detailed maps. None of these, of course, are so accurate as a telemeter; but imperfect as they are, they have given results, as in the case of the Austrian experiments, which are by no means to be despised.

What, then, will be the effect of the general introduction of long-range infantry fire? It will be necessary to take up the formation for combat considerably further off, and thus if faults are made in the original dispositions, they will be harder to repair.

The employment of reserves will be more difficult. If they are to be preserved intact, they must be kept well in rear, and as a consequence it will not always be possible to ensure their opportune arrival. The artillery will be forced further back, or will be obliged to resort to some such expedient as bullet-proof shields.¹

For the temporizing fight,² as in front or rear-guard actions, or for points where it is only intended to demonstrate, this nature of fire will be particularly suited. Again, it will often be possible by fire from long ranges to deceive the defender as to the real point of attack, and it will be of peculiar value in a pursuit.

On the defensive it will often obviate the necessity of occupying points which can now be covered from the main line.

¹ First used by Colonel C. Gordon, R.E., in China, and now proposed for introduction in the Artillery by Colonel C. B. Brackenbury, R.A.

² *e.g.*, Prussian attack on French left at Gravelotte, as it should have been conducted.

It will be of great advantage in turning movements, since it will be possible to pour in a powerful enfilade fire suddenly from a much longer range than has hitherto been the case.

One of its most important qualities is the power of using it over the heads of men in front, thus often enabling two or more stages of fire to be used. What the effect of this is has lately been seen round Plevna, where the Turks often had two lines of infantry, one above the other, causing thereby enormous losses to the Russians.

It will enable a much more powerful fire to be concentrated by the attacking force on any point of the defenders' line, since troops from more distant parts of the field can take part in it.

Lastly, in the case of troops attacking a position on the crest of a dominating plateau, they will be able to sweep its surface for such a distance to the rear as will render it much more difficult for the defenders to bring up supports and reserves to the threatened point.

Such are the arguments against and in favour of the employment of long-range infantry fire now in use on the Continent. It is for our readers to settle which side has got the better of the controversy.

Before concluding, however, we would say one word on the question of the rifle.

At present every nation of Europe is armed with weapons which are specially designed for effect at long range. It would seem more logical, therefore, either to make use of this property, or else to change the armament; for if short ranges only, up to about 500 or 600 yards, are to be employed, then a rifle constructed more on the principle of the sporting express could be made which would be far more effective.

But it is scarcely possible that this view should obtain many supporters. The history of the rifle shows a continuous progress in its accuracy at long ranges, it is probable that this progress will go on and that we may look in the future to as great an increase of power over the present weapons, as was obtained twenty years ago by Mr. Whitworth, when he brought out his rifle, the antetype of all modern infantry firearms.

The right path to pursue then is, first of all, to train the soldier thoroughly in the use of his rifle, not merely to make him a good target shot, but to teach him how to employ it as he must in war. Secondly, every effort should be made to improve his weapon. As it stands, the Martini-Henry is the best rifle in Europe; but there is no reason why it should not be improved. There is no finality in firearms any more than in tactics, and if the Napoleonic maxim be true, that to maintain pre-eminence it is necessary to change our tactical system every ten years, it is no less necessary to see that in the purely mechanical question of the rifle, we do not merely keep up with, or content ourselves with not falling behind other nations, but seek rather to go far beyond them.

TABLE A.

Back sight set for	Depth of dangerous zone covered by the projectiles.	Percentage of hits on targets representing				Using the under-given number of cartridges per sight.	Number of targets struck out of fifty representing men standing placed at equal intervals over a breadth of 110 yards.
		Men erect 6 feet high		Men lying down $\frac{1}{4}$ height of men standing			
		In line.	In company column.	In line.	In company column.		
450 yards.....	From the muzzle up to 500 yards.	50 to 70 p.c.	60 to 80 p.c.	15 to 20 p.c.	25 to 30 p.c.	200	35 to 41
550 "	110 yards	30 to 60 "	40 to 65 "	6 to 18 "	15 to 30 "	200	25 to 38
660 "	"	25 to 50 "	35 to 60 "	5 to 15 "	15 to 30 "	200	25 to 38
770 "	"	18 to 35 "	30 to 45 "	4 to 10 "	12 to 25 "	200	20 to 35
880 "	"	15 to 30 "	20 to 40 "	3 to 9 "	6 to 19 "	200	12 to 33
990 "	"	10 to 25 "	15 to 40 "	2 to 8 "	6 to 18 "	300	20 to 35
1,100 "	"	7 to 20 "	15 to 35 "	1 to 6 "	6 to 15 "	300	15 to 35
1,210 "	"	6 to 17 "	15 to 30 "	1 to 6 "	6 to 15 "	300	15 to 28
1,320 "	"	5 to 15 "	10 to 27 "	1 to 4 "	5 to 14 "	300	12 to 25
1,430 "	"	4 to 12 "	10 to 22 "	1 to 3 "	4 to 8 "		
1,540 "	"	4 to 10 "	10 to 14 "	1 to 3 "	4 to 8 "		



TABLE B

RESULTS OBTAINED WITH ONE

The men fired lying down with their rifles supported on any available object. The targets were 65 feet

Back sight adjusted for	No. of rounds.	Targets representing	Targets in front of mean centre of impact, distances in metres.																		
			200	190	180	170	160	150	140	130	120	110	100	90	80	70	60	50	40		
400 m.	100	Company in line	4	5	5	7	9	9	10	12	14	16	24	24	31	44	55	62	66	74	
		column	5	6	7	9	10	10	12	14	16	24	24	31	44	55	62	66	74		
500 m.	100	line								3	4	6	6	7	9	19	25	30	30	36	
		column								4	6	7	9	19	25	30	34	39	45	51	
600 m.	100	line									1	4	4	4	11	17	21	23	25	35	
		column									4	4	10	16	22	21	27	37	45	56	
700 m.	100	line												3	4	6	7	14	15	19	
		column												5	7	14	16	20	26	33	
800 m.	100	line											3	3	4	4	9	12	13	15	
		column											5	5	6	11	14	13	23	25	
900 m.	100	line										1	1	1	.	.	.	1	6	10	
		column										1	2	2	3	4	6	10	16	26	
1000 m.	100	line											1	3	4	3	4	13	18		
		column											1	3	5	4	6	11	24	26	
1100 m.	100	line													1	3	4	4	6	11	13
		column													4	6	8	11	13	12	17
1200 m.	100	line													2	3	.	1	2	2	6
		column													3	3	1	3	5	11	19
1300 m.	100	line													3	2	2	1	5	4	6
		column													5	4	5	7	11	12	18
1400 m.	100	line											1	.	.	3	2	4	4	2	
		column											1	1	3	5	8	7	6	5	

RESULTS OBTAINED WITH ONE HEIGHT OF S

400 m.	200	Company in line							1	.	.	4	6	11	17	28	29	24	34
		column							1	1	5	7	16	29	40	44	55	56	51
500 m.	200	line							1	2	2	1	.	.	.	1	2	5	5
		column							1	2	2	1	.	.	2	3	5	10	20
600 m.	200	line										2	2	2	7	11	17	23	26
		column										4	9	14	22	32	43	41	45
700 m.	200	line												3	4	4	13	12	17
		column												7	16	22	31	37	40
800 m.	200	line							1	.	3	2	1	2	1	2	4	2	4
		column					1	1	.	1			3	4	5	7	9	12	22
900 m.	200	line											1	.	1	.	2	2	2
		column											1	1	2	4	6	8	12
1000 m.	200	line													1	2	4	2	4
		column													5	7	6	7	21
1100 m.	200	line												1	2	.	2	1	.
		column											3	4	5	5	8	10	16
1200 m.	200	line												3	1	3	1	3	5
		column												5	6	5	4	12	20
1300 m.	200	line												1	2	3	3	2	4
		column											1	3	5	12	8	6	12
1400 m.	200	line													1	1	2	3	5
		column													2	7	9	10	20

RESULTS OBTAINED WITH TWO HEIGHTS OF SIGHT

Back sight adjusted for	No. of rounds with each height of sight.	Distances of the target																																							
		250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610			
		Number of h																																							
400 and 500 m.	100	9	10	12	14	15	18	24	26	30	44	53	63	68	74	74	78	70	70	82	66	69	57	57	60	64	68	63	55	50	43	32	21	16	17	15	16	15			
500 and 600 m.	100												3	4	4	6	7	9	19	25	30	30	36	42	55	60	68	69	67	65	60	52	52	62	62	66	65				
600 and 700 m.	100																																								
700 and 800 m.	100																																								
800 and 900 m.	200																																								
		Distances of the target																																							
		800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160			
		Number of h																																							
900 and 1000 m.	200	2	1	3	5	8	10	18	42	49	50	50	50	48	42	24	30	28	16	26	40	37	35	28	28	27	25	24	18	14	13	3	2	3	1						
1000 and 1100 m.	200																																								
1100 and 1200 m.	200																																								
1200 and 1300 m.	300																																								
1300 and 1400 m.	300																																								

N.B.—To turn metres into yards add one-tenth

WITH ONE HEIGHT OF SIGHT.

							Mean centre of impact.	Targets in rear of mean centre of impact, distances in metres.																					
60	50	40	30	20	10			10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	
Number of hits excluding ricochets.																													
4	53	60	64	70	68	71		61	61	57	36	29	21	16	9	8	4	5	5	6	6	5		4	3	3	2	2	1
2	66	74	73	79	77	77		68	66	57	37	31	22	17	12	11	5	7	7	6	6	6		4	3	4	2	2	1
0	30	36	41	51	56	64		58	50	44	37	27	17	13	14	13	14	14	13	8	7	4		3					
9	45	51	60	69	71	68		59	52	47	39	33	23	16	15	16	17	17	13	8	7	4		3					
3	25	35	49	48	49	52		51	47	34	31	24	24	16	11	5	3	.	1	2	2	2		1					
7	45	56	63	62	56	62		64	52	42	37	29	25	16	11	5	4	2	2	2	2	2		1					
4	15	19	26	26	29	35		28	33	32	26	29	17	13	6	3	4	5	4	4	3	2		2					
0	26	33	36	39	42	45		40	39	41	32	30	18	15	10	7	6	6	6	5	3	2		2					
2	13	15	19	24	24	31		27	29	23	19	14	8	5	3	1	2	1	1										
3	23	25	29	37	40	42		41	39	30	21	17	9	6	4	2	2	1	1										
0	6	10	12	14	24	31		23	23	22	19	13	7	5	6	5	3	1	2										
1	16	26	34	38	42	42		38	29	25	23	14	11	7	7	6	4	2	2										
4	13	18	14	9	15	27		26	13	5	7	9	10	3	1														
8	24	26	20	27	38	42		31	17	11	18	15	11	4	1														
5	11	13	9	7	17	18		17	14	12	15	11	5	2	.	2	1												
3	12	17	14	19	24	29		29	23	25	20	15	6	3	2	2	1												
2	2	6	12	13	15	22		14	10	6	7	2	.	1	2	2	1												
5	11	19	24	31	34	35		22	15	12	9	3	2	3	3	3	2												
5	4	6	10	8	8	14		7	10	8	6	3	2	.	1	1													
1	12	18	18	32	19	22		17	19	12	11	5	2	2	3	1													
4	4	2	3	8	10	11		10	9	17	9	4	.	1															
1	6	5	11	21	26	22		24	25	25	13	4	1	1</															

[illegible]

stances of the targets from the men firing in metres.

580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	------

Number of hits excluding riccchetti.

[illegible]

distances of the targets from the men firing in metres.

1130	1140	1150	1160	1170	1180	1190	1200	1210	1220	1230	1240	1250	1260	1270	1280	1290	1300	1310	1320	1330	1340	1350	1360	1370	1380	1390	1400	1410	1420	1430	1440	1450	1460	1470	1480	1490	1500	1510	1520	1530	1540	1550
------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

Number of hits excluding ricochets.

[illegible]

add one-tenth, *e.g.*, 100 m. = 110 yds. roughly.